NEW

HISTORY of WAR

WEAPONS of WAR

FROM PREHISTORIC ARMS TO 21ST CENTURY ORDNANCE

20 GREATEST WAR MACHINES

Digital Edition

FUTURE

SECOND EDITION

✪ THE FIRST WEAPONS ✪ HISTORY OF COMBAT

WELCOME TO

WEAPONS of WAR

The history of warfare is closely tied to the development of the weaponry that makes it possible. In this complete guide to weapons of war, you'll discover how the first true armaments were developed by paleolithic humans out of Stone Age hunting tools. You'll track the development of melee, ranged, mobile and defensive combat technologies from the ancient world to the present day, through encounters, pitched battles and tactical warcraft, and learn how the incredible innovation of black powder transformed the face of conflict forever. You'll see combat through the eyes of Egyptian charioteers, Roman legionaries, Mongol archers, English knights, Spanish tercios, US submariners, German air aces and many more, and explore the discoveries, tactics and technologies that put them at the top of their game in their particular theatre of war. You'll find strange, surprising and devastating devices and strategies throughout history, from Persian battle elephants to trench warfare, and explore today's myriad of inventive military technologies, which all started with the throw of a simple piece of pointed rock, thousands of years ago...

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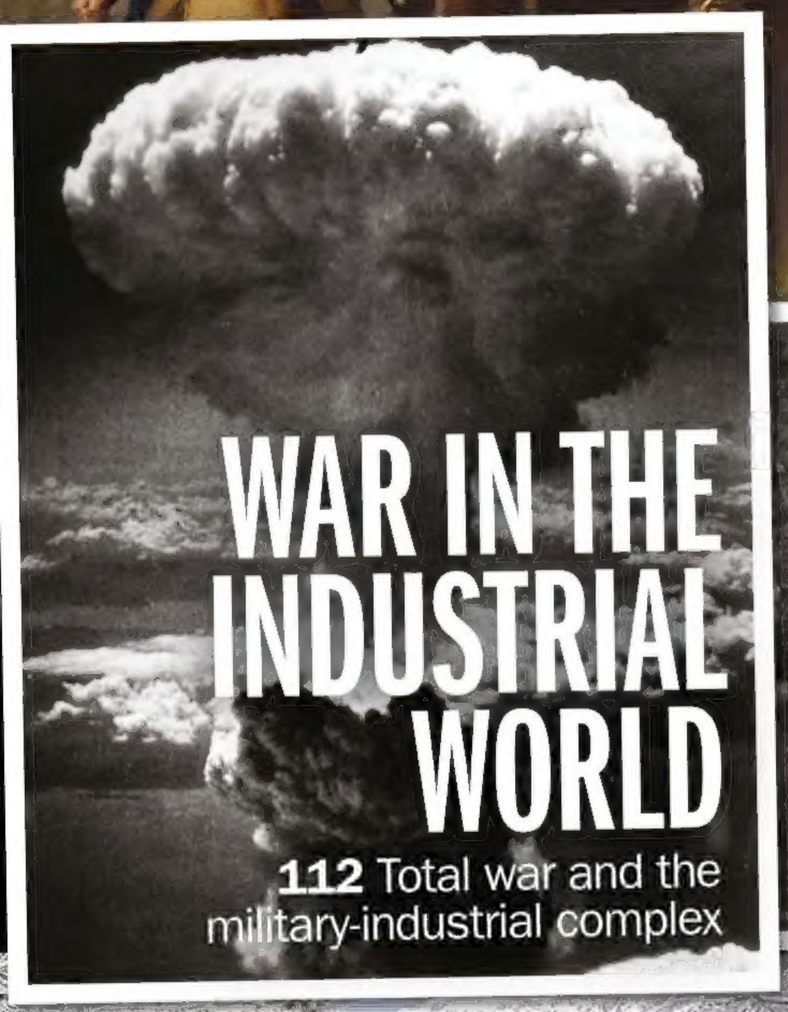

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HUNTERS, HEROES AND HOSTILITY

The story of weapons, from the attack tools of the Stone Age to the advanced technologies of today

WORDS **EDOARDO ALBERT**

Defining moment

SWORD
1200 BC

While bronze, sickle-shaped khopesh swords existed by 2500 BCE, the sword as a defining weapon required the perfecting of iron smelting technology before it could become a truly effective weapon of war. The sword was the first tool made exclusively for war: it had no other function save to kill. In this, it proved supremely effective; the short iron gladius, the blade of which was only about two feet long, was for centuries the characteristic weapon of Roman legionaries, which they used to cut down the enemies in Rome's path to domination of the ancient world.

THE HISTORY OF WEAPONS

FLINT AXE
When a haft was bound to the previously handheld flint axe, the additional leverage that the haft provided made the already sharp flint axe into a truly formidable weapon.
PREHISTORIC

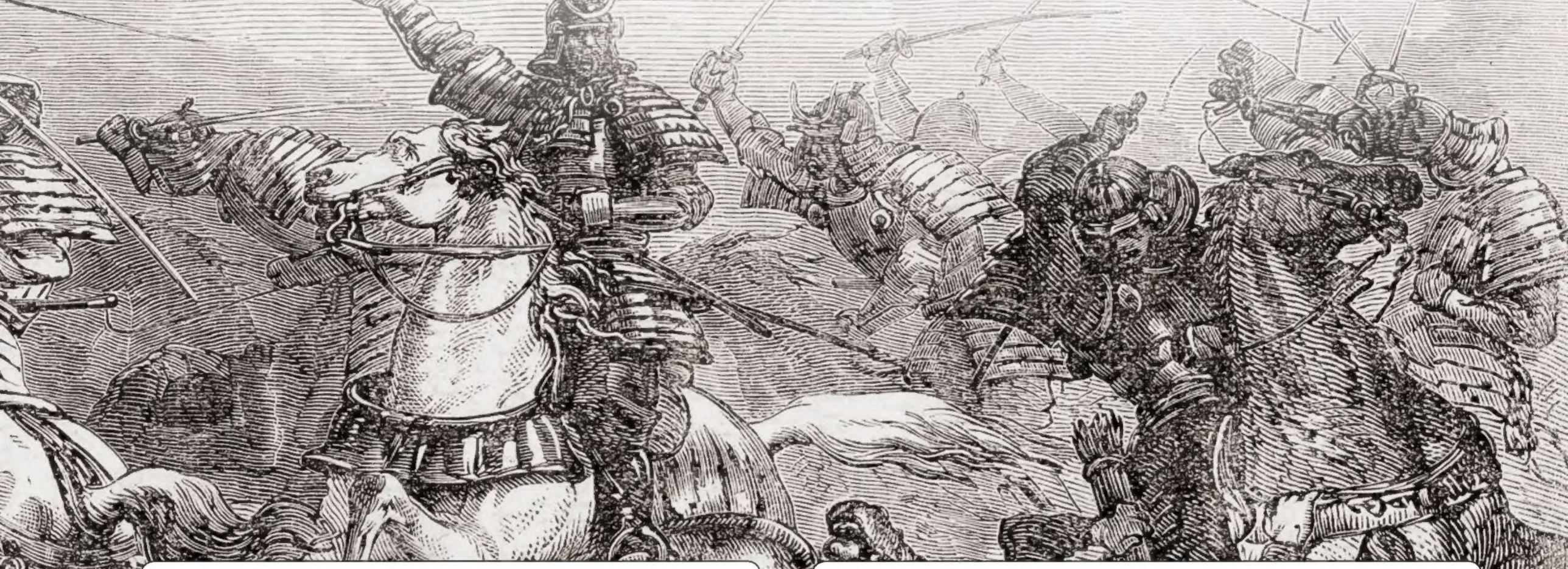
BOW
The bow was a great hunting weapon: its refinement into composite and recurved designs made the bow a devastating weapon, especially for the mobile tribes of central Asia, contributing to the conquests of Genghis Khan.
PREHISTORIC

CHARIOTS
The first mobile military platform had as transformative an effect on the ancient world as the tank had on the modern world. The light, two-wheeled chariot developed in Central Asia carried a driver and archer swiftly over the battlefield, allowing the precise employment of force on the weak points in an enemy's formation.
c.2000 BC

LONGBOW
Longbows recovered from the Mary Rose measure between six and seven feet, requiring a pull weight of 150lb. Modern bows have pull weights of 50lb. These longbows required a lifetime's training, but in the hands of trained archers they became the most devastating ranged weapon of the medieval era.
MEDIEVAL PERIOD

KNIGHT
Stirrups, increasingly effective armour, the breeding of warhorses and the martial culture that accompanied all of this brought onto the battlefield the medieval knight, a battlefield presence as devastating in his time as the tank in the modern world.
MEDIEVAL PERIOD

Through most of the time human beings have lived on this planet, methods of warfare and their concomitant technologies have been limited within cultural spheres, their interchange limited by reasons of geography, topography and sheer distance. Thus a South American tribesman, armed with a deadly blowpipe and operating in a rainforest environment, fought very differently from a Roman legionary. While all military cultures were unique, geographic and cultural connections created a number of distinct military zones: Japan, Mesoamerica, Southeast Asia and India, Europe and the Middle East, and China. Once the culture and technology that allowed a rider to wield a composite bow was perfected, the Central Asian steppes became another distinct military zone. So long as the different zones remained separated by the difficulties of long-range transport, they continued to fight wars in their own distinctive styles and with their own weapons. However, when the European nations developed ocean-going sailing vessels armed with cannon in the 16th century, the rival European powers were able to impose their own style and methods of waging war upon the rest of the world by dint of their brutal effectiveness: European navies and armies won when pitched into battle against the other military cultures and technologies of the world. War is predicated on the simplest and clearest of metrics: life and death. Faced with the death of their defenders and the loss of their lands, the other nations and cultures of the world adopted, at varying rates and with different degrees of success, the European way of waging war. Now, in the 21st century, warfare has become a truly cross-cultural activity, with methods and technologies, from drones to IEDs, adapted and adopted with the rapidity that modern communications and the internet (itself first designed for military use) allow. What the future will bring us is difficult to say, beyond this: warfare will change, it will fluctuate in intensity, but it will not end. It is as old as humanity. It may, one day, be the end of us. This is the story of this most human of activities: the story of war.



Defining moment

MAN-OF-WAR 1571–1862

The fitting of banks of cannon into ocean-going sailing ships allowed competing European countries to project naval power worldwide and, in doing so, to create ocean-linked empires. Where before warcraft was divided by culture and geography into distinct zoned areas, with the perfection of the man-of-war in its various forms, from sloop and frigate to ship-of-the-line, the European way of waging war and its concomitant weapons were slowly imposed upon the rest of the world, for the simple reason that they were more effective than any of the other weapons cultures in the world.

Defining moment

AEROPLANES 1903 - PRESENT

The long dream of flight, once accomplished by the Wright brothers in 1903, was turned to warfare just over a decade later. The First World War drove aircraft design with all the desperate efficiency of total war and, by the conflict's end, discrete fighter and bomber designs had evolved. Throughout the 20th century's many wars, air superiority became an increasingly important element in warfare: the Luftwaffe's failure to defeat the RAF during the Battle of Britain spared the UK a Nazi invasion. The wars of the 21st century have seen remotely controlled drones play increasing roles in reconnaissance and interdict: these roles will likely grow greater in the years ahead.

EARLY CANNON
In 1453, cannon built by a European weaponsmith named Urban were used by the Ottomans to bring down the walls of Constantinople and end the Byzantine Empire. The golden age of the castle was over.
14TH-15TH CENTURIES

LIGHT FIELD ARTILLERY
Early cannon were extremely heavy and very cumbersome. But improvements in casting cannon, and the use of teams of horses to move gun carriages, allowed the use of field artillery that was one of the defining features of the battlefield during the Napoleonic Wars and onwards.
18TH CENTURY-PRESENT DAY

FLINTLOCK
Early muskets were slow and difficult to load and fire. The flintlock mechanism, developed by Marin le Bourgeoys for Louis XIII of France, became the standard firing mechanism for muskets for over two centuries; as a result, devastating volleys of musket fire became the standard infantry tactic.
EARLY 17TH CENTURY-MID 9TH CENTURY

TANKS
Developed to break the stalemate of the First World War, tanks would play a crucial role in the Second World War, with the Wehrmacht's blitzkrieg tactics allowing for the lightning conquest of much of Europe.
1916-PRESENT

FROM STONE AXES TO IRON SWORDS

The long journey from adapted tools to devices designed solely for killing: human history is the tale of better ways of dealing out death

The first weapons of war were originally tools of the hunt, pressed into service in the killing of different prey: the club, the fire-sharpened stick that became the first spear, even a good hard rock can deliver a skull-crushing blow. But two fundamental inventions served to transform tools into weapons. The first was the gradual refinement of flint knapping, which allowed skilled Stone Age tool makers to chip lumps of flint into steadily sharper and more deadly implements, culminating in the hand axe that was ubiquitous in the Paleolithic era. Then came the discovery that principles of leverage meant that fixing an axe head to a haft produced far greater power, as well as giving the person wielding the axe a defensive distance from the person they were hitting with it. With that, the first true weapon was born. Of course, axes still continued to serve other purposes, as did other early weapons, notably bows and arrows. The first evidence for bows dates to 20,000 BCE, and archers are depicted in the oldest representation of human combat, cave paintings in Iberia that date from the Mesolithic period (it's difficult to date cave paintings, but these are probably between 5,000 and 9,000 years old). The paintings show groups of archers engaged in battle, sometimes with the defeated men running away. While spears, throwing axes and, in Australia, hunting boomerangs (which do not come back) were other examples of ranged weapons, the bow and arrow would remain the key long-distance weapon until the widespread adoption of firearms from the 16th century onwards; bows were therefore key weapons for 200 centuries, making them the weapon with the longest military use in human history.

When bows were married to a new method of mobile warfare, the chariot, the resulting combination of fast-moving ranged power became the military basis for the world's first empires. Chariots developed from four-wheeled wagons, themselves the result of two fundamental inventions, the domestication

One of the earliest depictions of warfare, this cave painting from Morella La Vella in Spain, is between 5,000 and 9,000 years old

Flint, chipped into points for axes, spear heads and arrow tips, was the first known, crafted weapon

HORSES FOR HEARSES

While the dog was mankind's companion in the hunt, the horse became his comrade in war. Horses were first hunted for meat, probably utilising dogs running alongside their human companions. But human hunters found something deeply moving about these prey animals: horses appear more often in Paleolithic cave art than any other animals. In the vast steppes of what are today the Ukraine, south-west Russia and west Kazakhstan, the horse was first domesticated as a herd animal to provide meat. Horses were better suited to the extremely harsh winters on the steppes – horses can break through ice and snow with their hooves to feed on winter grass – than cattle or sheep, but soon afterwards, probably as a prank, a child jumped up on to the back of a horse and sat there. The world was transformed, both for the child and the people watching. By 3500 BCE, there is evidence from the wear on horse teeth found in Kazakhstan that the horse had been biting on a leather bit: people were riding. The mobility that riding on horseback allowed transformed the cultures of the steppes. Once settled civilisations developed on the fringes of the steppes, these rich and static cultures became the target for waves of nomadic, horse-riding invaders from central Asia, culminating with the Mongols of Genghis Khan, the last and greatest nomadic irruption into the steady patterns of farm-based civilisations that grew up in cultivated areas.

This Roman mosaic from Cyprus features duelling gladiators using the gladius and scutum

of the horse and the invention of the wheel, and went on to dominate the battlefield in the Near East for a millennium, until they were supplanted by cavalry and improved infantry tactics, although some peoples, including the Britons, continued using chariots on into the Roman era. The first great exponents of infantry formations were the Greeks. The hoplite, armed with spear and shield, was the infantryman that, when marshalled into phalanxes, defeated the Persian Empire and ensured the survival of the Greek city states. The Greeks were citizen soldiers and many were farmers. In the many internecine wars of the Greek states, all parties knew that the army could not stay long on campaign, so Greek martial culture developed the idea of the pitched battle, where the winner took all, including the lives or at least the freedom of the defeated. This all-or-nothing attitude to battles was a particularly Greek innovation, different from the expediency that ruled other cultures of the time, who generally saw nothing wrong in living to fight another day. But the Greek soldiers of this early period did not have another day: they needed the war brought to a conclusion. Other cultures have also decided victory by different metrics: counting coup among the Native Americans is one example. However, the Greek way of warfare quickly became the standard throughout Europe and the Near East, particularly in the wake of the conquests of Alexander, before spreading worldwide with the European expansion from the 16th century onwards.

While the Greek hoplite was the first truly successful foot soldier, it was the Roman legions that perfected infantry tactics and strategy in antiquity. The legionary was the product of professional training and logistics – the army was by far the largest arm of the Roman state – and mass-produced iron weaponry, most particularly the sword.

The sword was the first pure weapon: it has no other function save to kill. However, a sword presents unique metallurgical difficulties, which meant that it only became a truly effective weapon following the perfecting of the technologies required to refine and forge iron ore. An effective sword has to be both malleable, so that it will not snap in combat, and hard, so that it can take and retain a cutting edge. Iron is actually quite malleable but not very hard: a sword made from pure iron will not break in battle, but after a few blocked strikes it will lose its edge, becoming little more than a long, pointy club. Steel – iron alloyed with carbon – is extremely hard but brittle: the best steel can be sharpened to the finest edge but a lateral blow could shatter a steel sword. The solution adopted by sword makers was to marry the two, welding a steel edge on to an iron core, thus creating a truly devastating battlefield weapon. The Romans mass-produced swords for their legions, but sword smithing technology continued to develop after the fall of Rome, reaching its zenith among the Anglo-Saxons and the Vikings, whose smiths created pattern-welded blades of extraordinary quality and beauty.

The gladius, the sword of the legionary, was a more basic killing device, but coupled with the scutum (shield), the pilum (javelin) and the tactics and logistics of the Roman army, they made an all-conquering combination for centuries, creating and maintaining the largest and most enduring empire of antiquity, and the only one in history to control all the shores of the Mediterranean.

Knights devoted their lives to the study and practice of war, and tournaments helped develop and maintain the skills they needed to survive

HORSE SOLDIERS

How troops on horses changed the face of warfare – and created the largest land empire in history

If antiquity was the age of the infantryman, then the thousand years from the fall of Rome to the fall of Constantinople was the age of the cavalryman. The invention and adoption of stirrups, which help a rider stay on top of their horse when making violent impacts with sword or spear on an enemy, coupled with the breeding and raising of horses suitable for the various roles of the cavalryman, made this millennium a time of mobile warfare, interspersed with long drawn-out sieges. For the other great advance of the age was defensive: the castle and similar fortifications became well-nigh impregnable strongholds, dominating centres of power that overawed all the land and people around.

While the knight in armour is the defining image of the medieval period, cavalrymen came in a number of different guises during this time. The European knight came into his own under Charlemagne, who needed a mobile strike force for his huge empire, and then was developed further by the Franks and the people they ceded part of their country to, the Normans. This was the heavily armed and armoured knight of legend, a sort of medieval tank. However, there were other highly effective cavalry during this period, none more so than the riders of Genghis Khan's conquering armies. In the 13th century, the nomadic tribes of central Asia swept out of their plains, heading both east and west, defeating all the armies that they met. In this extraordinary series of campaigns, the Mongolian cavalry and their horses were crucial. Yes, horses. Each cavalryman had a number of horses, as many as eight. So the first requirement for the success of these cavalry armies was the breeding and keeping of vast herds of Mongolian ponies, a relatively small but tough breed of horse. The warriors themselves used a composite recurve bow, carrying a shorter bow for long-range skirmishing while riding and a longer bow to be used on foot. Being able to shoot a bow while riding at speed, combined with the ability to switch to devastating volleys of arrows from their long bows when called upon to dismount, made the Mongolian cavalry the most devastating horse soldiers of the era and allowed Genghis Khan and his descendants to establish the largest contiguous empire in history. But in the history of weapons, a successful weapon always calls forth a counter. The impact of a charging knight on an infantry line was devastating.

The solution? Stop him getting to the line. Either at long distance, through volleys of arrows, or at short range, by creating an impenetrable spiky barrier with a wall of pikes and halberds. As a ranged weapon against knights, the crossbow was extremely powerful and required little training, but its shooting rate was too slow to stop a massed charge.

The longbow was nearly as powerful, and a trained longbowman could shoot six aimed arrows a minute, or 12 without aiming, but it took years to build up the muscles and skill to use a longbow effectively. The knightly caste hated archers and seldom gave them quarter in battle, thinking it an offence against the social order that a low-born archer should be able to bring down an armed and mounted nobleman.

Genghis Khan's mounted archers were one of the most formidable forces of the medieval world

"THE MONGOLIAN CAVALRY WERE THE MOST DEVASTATING HORSE SOLDIERS OF THE ERA AND ALLOWED GENGHIS KHAN TO ESTABLISH THE LARGEST CONTIGUOUS EMPIRE IN HISTORY"

Military architecture reached a peak during this era, producing fortresses such as Krak des Chevaliers, the formidable Hospitaller castle in Syria, and the 'ring of stone' that Edward I's engineer, Master James of Saint George, constructed in Wales to cement the king's conquest of the principality. Castles such as Krak des Chevaliers, Caernarfon and Conwy were almost impregnable to assault, being designed so that the defenders could rain down arrows, and other things, upon any besiegers attempting to breach either walls or gate. Although medieval engineers did develop impressive trebuchets to hurl stones at castle walls, and if the ground allowed then a besieging army might try to mine the walls, in most cases a siege was successfully concluded through starvation or treachery: it was rare for a castle to be stormed.

But on the other side of the world, a new invention, a black powder, was being developed that would bring an end to the era of knights and castles. The Chinese had been experimenting with different compounds since the 1st century and by the 7th they had invented fireworks. By the 8th century, saltpetre (ground potassium nitrate), charcoal and sulphur was mixed in the ratio 75:15:10: black powder. But initially, this black powder wasn't used in guns.

It was first employed as an incendiary, then as a simple bomb and, when the powder was mixed with oily hydrocarbons to create a propellant, to shoot 'fire lances'. These first lances, which looked like a rocket firework, were inaccurate and not very lethal, but by firing massed volleys of them, the Chinese created a useful barrage weapon that was particularly effective against armies that had not encountered such weapons before. They created terror and panic.

The technology, once invented, spread rapidly: there are accounts of rockets from Spain and Italy in the 13th and 14th centuries. When the black powder was taken out of the rockets and put into a tube, it would start a revolution in warfare and weapons, a revolution that continues to this day.

GREEK FIRE

Around 672, a Greek named Kallanicus created a substance that came to be called Greek fire. It was probably made from petroleum-based liquids mixed with saltpetre and quicklime – its exact constitution was a Byzantine state secret and has been lost – but it allowed a stream of burning liquid to be hurled at enemy troops and, especially, enemy ships. Once lit, Greek fire could not be put out with water and it was viscous and sticky, covering ship or sailor with a coat of flame that could not be removed. Greek fire was mainly employed by the Byzantine navy, being delivered onto enemy ships either as clay grenades that were wrapped in burning cloths and shot with catapults at the enemy, shattering on impact and spreading Greek fire everywhere, or aimed as a jet of liquid flame from a bronze tube, known as a siphon. The effect, on wooden ships and the half-naked crews of rowed galleys, was devastating.

A 12th century illustration showing Greek fire spouting from the bronze siphon in the prow of a Byzantine ship

FROM BLACK POWDER TO NUCLEAR POWER

The invention of gunpowder ushered in an era of technological change: wars were now fought as much in the laboratory as in the field

While the Chinese invented black powder, it was the Europeans who turned it into gunpowder, and put it first into cannon and then 'handgonnes'. Indeed, it was a European, Urban, who designed and cast the huge cannon that the Ottomans used to batter down the walls of Constantinople in 1453. The fall of the city ended both the Roman Empire and the age of high-walled fortifications: proof against the sort of missiles that a trebuchet could throw, even the walls of Constantinople could not withstand the high-velocity impacts of cannonballs. Urban had first offered his gun-making services to the Emperor of Constantinople but when Constantine XI could not afford Urban's wages, he went to the sultan, Mehmed II, who was more than happy to pay whatever the master gunsmith wanted. While Urban provided the means to destroy the walls of Constantinople, he did not live to enjoy the spoils: Urban and his crew were killed when one of their cannon exploded – a not infrequent occurrence with early cannon.

Such was the progress of siege work cannon that by the end of the 14th century, 50 years before the fall of Constantinople, bombards were shooting stone cannonballs weighing more than 200kg (450lb). Iron cannonballs, being much denser than stone, could not be made so heavy but because of their density they were incredibly destructive against static defences such as walls. The age of the castle was over.

While artillery made the first military use of gunpowder in Europe, by the middle of the 15th century hand guns were coming into use. The first hand guns were essentially just smaller cannon, but with the development of the matchlock firing mechanism, the wheel lock and then the flintlock, and the fitting of gunstocks and grips, the hand-held gun became the stock infantry weapon. The accurate range of musket fire was short, less than 100 yards, so its effective use required infantrymen to be trained to fire, reload and fire again, in volleys. The regimented lines and columns of 18th and 19th-century warfare were the direct result of the weapons the troops were using, demonstrating how weapons and tactics evolve alongside each other. When rows of cannon were fitted into the new ocean-going sailing boats that the European maritime nations started building from the 16th century onwards, the resulting warships in all their variety, from sloops through to the vast floating gun batteries that were the ships of the line, became potent ways of projecting force across the world's oceans. These sailing ships ushered in the Age of Exploration and as European sailors and navies crossed the waters of the globe, they imposed European methods of fighting wars on all the cultures they met, for the brutally simple reason that the European powers generally won. The different military cultures that had existed before the era of European expansion were abandoned in the face of the clouds of smoke and rolling thunder from the broadside of a frigate or man-of-war. Even Japan, which had turned its back on the rest of the world in an effort to retain its own military culture, was forced into acceptance when Admiral Perry of the US Navy, commanding a fleet engaging in gunboat diplomacy, forced the Japanese to sign the Convention of Kanagawa in 1854, opening the country to American trade. The Japanese would prove swift learners in the new way of warfare. By the late 19th century, the countries of Europe had essentially carved up the world among themselves. The 20th century saw the principles of research and innovation that had given Europe this military advantage turned in on the continent, producing the two greatest conflicts in human history. Driven by

"THE MUSHROOM CLOUDS OVER HIROSHIMA AND NAGASAKI BROUGHT AN END TO THE ERA OF ALL-OUT WARFARE: CONFLICT BETWEEN NUCLEAR POWERS WOULD BE MUTUALLY SUICIDAL"

The battles of the gunpowder age were wreathed in smoke, the fog of war, as seen here at the Battle of Waterloo in 1815

THE FIRST SUBMARINE

It was 1863, and during the American Civil War the Confederate South was being starved by the naval blockade of the Union navy. To try to break the blockade, the Confederates built a submarine, the CSS Hunley. It was crewed by eight men, seven turning the propeller by hand, one steering; they also pumped out the ballast tanks by hand. The Hunley was fitted with a spar torpedo, a metal bar with a barrel of gunpowder attached to it. The idea was to embed the spar into the side of an enemy ship, then for the Hunley to reverse away from the ship, pulling tight a lanyard that, when taut, would set off the ignition mechanism in the barrel of gunpowder. On 17 February 1864, the Hunley set sail from Charleston harbour, its mission to sink the USS Housatonic. The Hunley, submerged, approached the Housatonic but its sailors spotted the submarine and opened fire with rifles, to no effect. The Hunley embedded the spar torpedo into the side of the Housatonic, turned round and pulled away, drawing the lanyard tauter and tauter. When the Hunley had got 50 metres away, the barrel exploded. The explosion ripped open the Housatonic, its own magazine igniting in the process. Within a few minutes, the ship had sunk, the first victim of submarine warfare. The Hunley, however, never returned to Charleston. It sank, with all hands, possibly as a result of the shockwave from the explosion.

On 8 August 2000, the Hunley was raised from the seabed where it had rested since 1864. The remains of the crew were buried with full military honours in Charleston

The cloud that rose above Nagasaki on 9 August 1945, after the explosion of a 21 kiloton nuclear bomb 500 metres above the city

the brutal necessities of industrial warfare, new weapons and weapon systems defined the century's conflicts. Of these, the two most important were aeroplanes and tanks, although in terms of people killed, it was the continually refined science of the gunner that took the greatest toll, artillery chalking up a huge quantity of dead during the First and Second World Wars.

Aeroplanes and tanks became the defining weapons of the 20th century. Muskets and artillery had brought an end to the age of cavalry: the wars of European expansion and the global Napoleonic Wars were essentially infantry and naval battles. But the tank on land and the aeroplane in the sky remade land and naval warfare: the tank, with its mobile firepower, ensuring that the Second World War did not replay the trench warfare of the First, and the aeroplane, taking off from vast naval aircraft carriers, brought the age of the man-of-war, in its last iteration of the steel battleship, to an end. Henceforth, naval wars would be won or lost in the sky or underwater, where the invention of the submarine brought an entirely new theatre into the playhouse of war. War was now total, involving conflict in the air, on land, on sea and under water.

But the mushroom clouds growing over Hiroshima and Nagasaki brought an end to the era of all-out warfare: any such conflict between nuclear powers would be mutually suicidal. The 21st century has seen continued innovation in the smaller scale wars that have so far been characteristic of the period, from unmanned drones to IEDs; cyber warfare to terrorists driving trucks into crowds of civilians. War remains the most characteristic of human activities, the complex multi-theatre warfare of the cyber age disrupted by the force multipliers of suicide bombers and media coverage.

However weapons change in the future, one thing remains all too certain: they will be used in future wars.

The Lockheed Martin F-35 Lightning II is a fifth generation multi-purpose fighter jet

THE ANCIENT ERA

ANCIENT WEAPONS AND WARFARE

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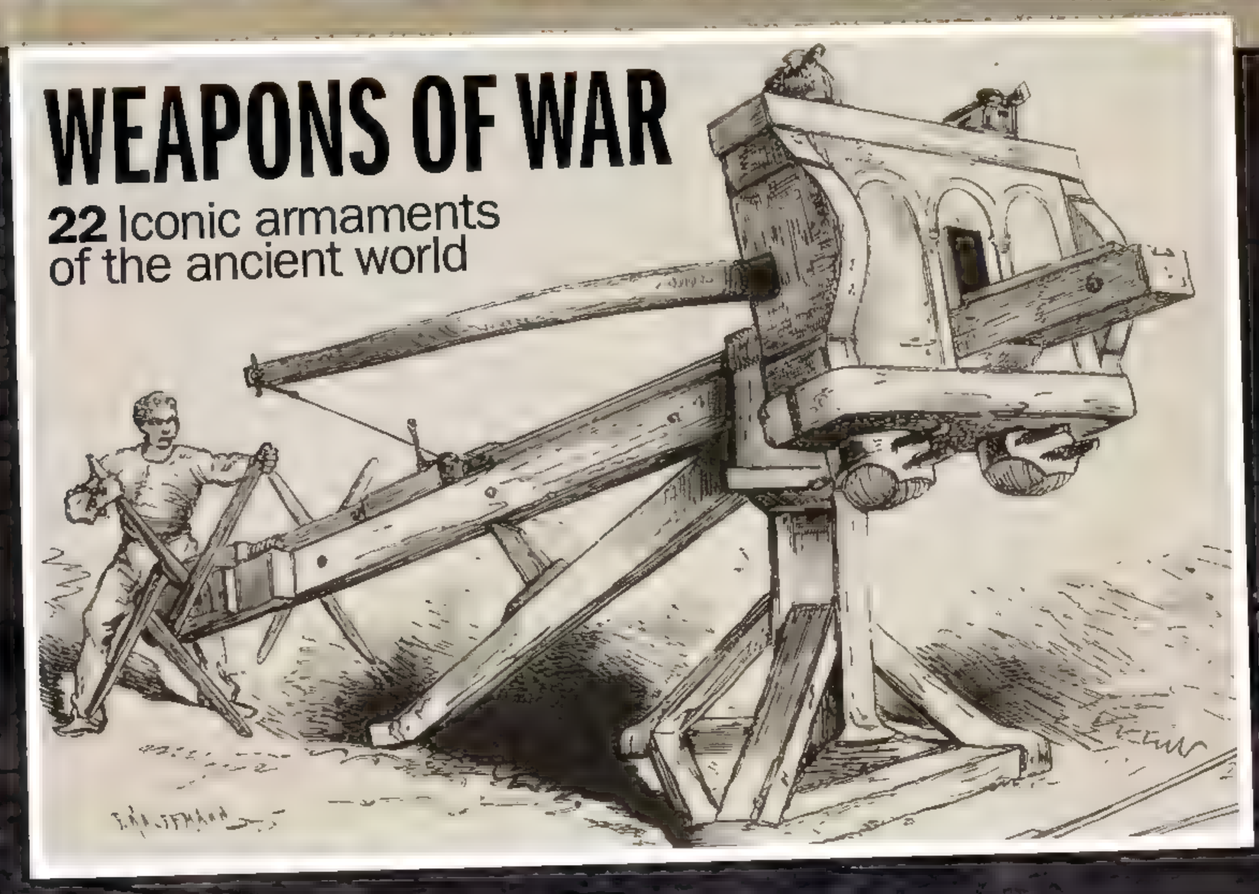
WEAPONS OF WAR

22 Iconic armaments of the ancient world



THE BATTLE OF KADESH

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"IF A SETTLEMENT STOOD IN THE WAY OF THE ROMAN JUGGERNAUT, THE TRUE POWER OF THE EMPIRE'S SIEGE ENGINES WOULD BE UNLEASHED ON THEM"

ANCIENT WEAPONS AND WARFARE

WORDS BEN GAZUR

The history of humanity is the history of war; the development of weapons in the ancient world traces the development of civilisation

Humans are, and always have been, inventive in the tools they create to harm one another. A history of humanity could easily be constructed from an examination of the weapons and tools of war we use. The earliest weapons were constructed from wood and stone, and predate modern humans. We cannot know anything about their creation, but through the rise of settled civilisations and writing we can trace the development of this arsenal.

Up close

All early weapons' effectiveness depended on the strength on their user. As civilisations appeared, more efficient ways of using that strength were invented. In close combat, blades were the weapons of choice. With the development of metallurgy, daggers, swords, and arrowheads achieved new levels of sophistication.

The first major advance in metal weaponry was the development of bronze. This alloy of copper and tin allowed for the creation of slashing weapons and sharp-pointed spears and arrows. Bronze technology spread unevenly in the ancient world, but wherever it went it changed the nature of warfare. The need for bronze led to increased trade – and competition for the resources to make it – across the ancient world. Only with the invention of efficient iron smelting did the Bronze Age pass.

Iron could be toughened by the addition of carbon to make steel, which was the real point of transition in military technology. Against steel, bronze had little chance. Steel weapons could be complex – the Roman gladius was sometimes made of two types of steel with different levels of carbon, beaten together to create a blade.

Besides the slashing and stabbing of swords, soldiers could use other close-range weapons to kill their enemies. Spears and axes offered different methods. A spear could impale your foe before they even reached you. The Macedonian sarissa, at six metres in length, offered a formidable obstacle to both infantry and horses. If your enemy was armoured then a sword might not have been able to penetrate their defences. A well-swung and heavy axe-head, on the other hand, could crush even the best-armoured foe.

Danger at a distance

Projectile weapons offer users the protection of distance. If you can strike your foe before they can get within a sword length of you, you are more likely to survive. Bows and

arrows are known from prehistoric sites, but innovation throughout antiquity improved their power and use. The compound bow was made by laminating horn, wood and animal sinew together. This composition of materials made for a more powerful and compact weapon. The origin of the crossbow is debated, but it is widely attested in the Chinese Warring States period (5th-3rd century BCE). Chinese armies of the time would carry large numbers of professionally constructed crossbows with them.

Other projectile weapons like javelins were less portable than arrows, but could deliver a much more deadly blow. A soldier might carry several light javelins to hurl at their opponent as a preliminary to an infantry charge. Other weapons required more specialised training, such as the slingshot. Shooting stones and lead pellets, an ancient sling could do as much damage as a modern bullet. To add insult to injury, slingshots have been found with taunting phrases (like "Take that!") carved on them.

The ability to launch heavy projectiles developed relatively late in antiquity. Greek armies and ships made use of ballistae – machines that placed rope under heavy torsion to power their shooting. It was said that a single man could load and shoot a ballista. They were simple enough to be disassembled and reassembled as needed, yet powerful enough to take down armoured foes with shaft projectiles, and to be used as siege weapons with spherical ones. Greek vessels would use them to launch pots of flammable liquid – or in some cases poisonous snakes – onto other ships' decks. With further developments under the Romans, these weapons were able to shoot a dart over a kilometre.

Mobile units

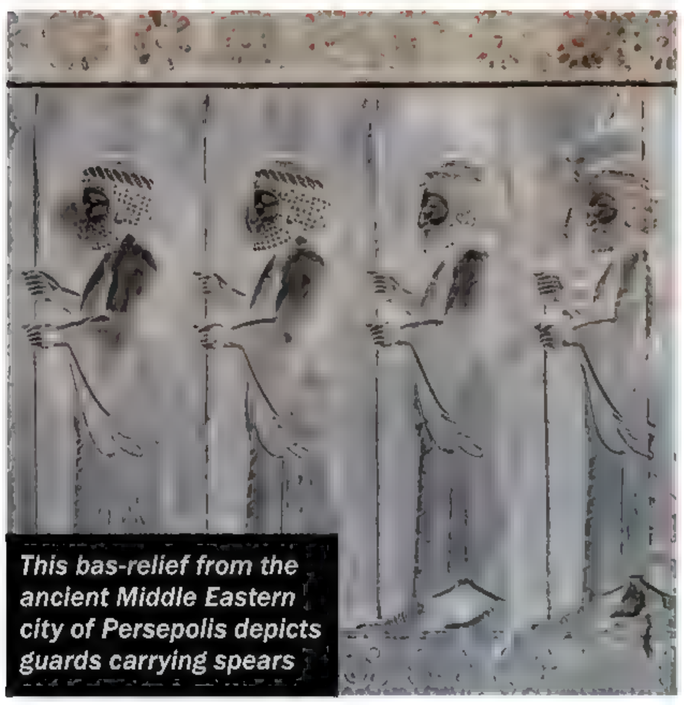
An army on the move is not a fast thing. Having to carry supplies for a campaign only further slowed down progress. Perhaps the earliest use of animals in warfare was to use them to carry materiel. Horses fulfilled the dual role of transport and use in battle. A mounted scout provided much-needed time to move an army by giving advanced warning of an approaching enemy. The saddle and stirrups were not invented until the very end of antiquity, making horses difficult and uncomfortable to ride. It is likely that the first chariots were developed from transport carts. These provided excellent positions for archers to fire from. Over time, chariots became swifter, lighter and more dangerous.

Horses were not the only animals to see use in warfare. In the Near and Middle East, archers used camel squadrons. In India, elephants were used from the 6th century BCE onwards, and their use spread westward. The sheer bulk of elephants shattered infantry and cavalry alike, and many archers could shoot from their backs. Hannibal's efforts to get elephants over the Alps in his attack on the Romans show how valued they were as weapons. The first elephants seen in Britain for thousands of years came with the invading force of the Roman emperor Claudius.

Defend yourself

In a battle, a shield can be your best friend, and in the ancient world many types of shield were developed and used by different armies at different times. These ranged from simple and light to complex and heavy. The Parthian empire had soldiers that used wicker shields. Lightweight, they were planted in the ground to provide a wall for archers to hide behind. The tower shield of the Mycenaean infantry

"PROJECTILE WEAPONS LIKE JAVELINS WERE LESS PORTABLE THAN ARROWS, BUT COULD DELIVER A MUCH MORE DEADLY BLOW"



This bas-relief from the ancient Middle Eastern city of Persepolis depicts guards carrying spears

The double-headed axe, or labrys, became an iconic symbol of the Minoan civilisation of Crete

METEORIC IRON WEAPONS

Creating weapons from bronze was a huge advance in weapons technology. Casting allowed metalworkers to create swords, daggers, and arrowheads in a variety of shapes. Bronze armour, although particularly heavy, would offer almost complete protection. The major drawbacks with bronze are that it requires tin to create, and does not hold a sharp edge. With the development of iron smelting (~1300 BCE in the Near East), bronze weapons fell into disuse. Yet archaeologists have discovered iron tools and weapons from periods well before iron could be mined.

These Bronze Age iron artefacts range from daggers from 2500 BCE in Turkey, to axe heads from 1400 BCE found in both Ugarit and China. Where did Bronze Age people get iron from? The answer is from space, though not from aliens.

Iron meteorites are able to withstand entry into the Earth's atmosphere. Even to the untrained eye they stand out, and so ancient people would have collected them and known they were special.

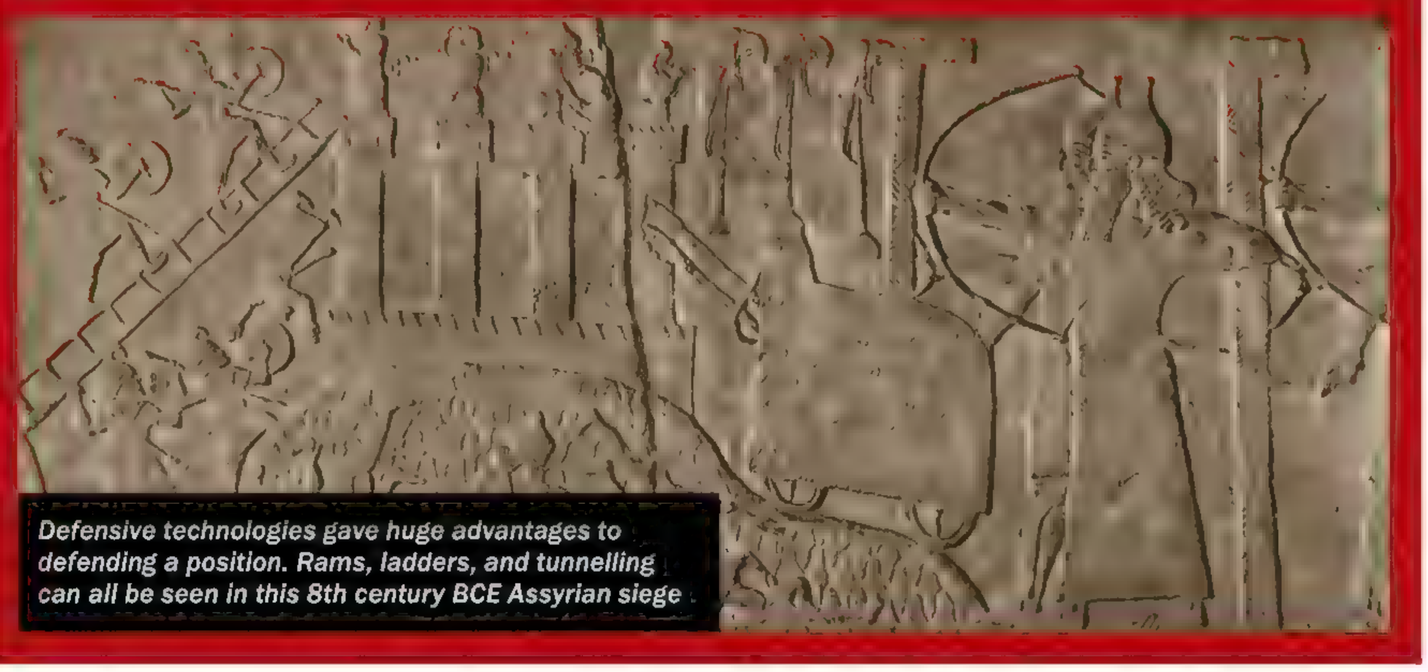
While smelting iron ore requires very high temperatures, a lower-temperature furnace will allow you to work iron into a desired shape. Iron, especially iron that fell from the heavens, would have been treated as a prestigious material.

Scientists who discover iron artefacts can analyse them for the relative quantities of other elements in the metal to see whether it is extraterrestrial in origin. A high level of nickel and cobalt points to the iron coming from meteorites. The tomb of Tutankhamun contained a dagger that recent work has confirmed was made from meteoric iron.

This dagger found in the tomb of Tutankhamun has a blade made from meteoric iron. Meteors are an easy, if rare, source of iron

THE ART OF THE SIEGE

"Ascend and walk about on the wall of Uruk, inspect the corner-stone, and examine its brick-work, whether its wall is not made of burned brick..." The *Epic of Gilgamesh* describes the walls of the city of Uruk as one of Gilgamesh's greatest achievements. Written in ~2100 BCE, it shows how important defending cities and towns had become. One person up on a wall is able to keep many warriors below at bay. For many centuries the thick walls of cities was more than a match for any army outside. Sieges began as simple exercises in holding an enemy captive in their own town and starving them out. This takes a lot of time, and requires the attacking army to put a lot of resources into the effort. The word 'siege' derives from the Latin 'sedere', meaning to sit. Our earliest records for sieges are the friezes from Egyptian tombs and Assyrian palaces. These show how the besieging army could speed the capitulation of a town. The simplest method of getting an army inside the walls was to climb over them. Egyptians used wheeled ladders propped against the walls. This left soldiers climbing them vulnerable from attack above. Assyrians developed complex battering rams to breach the walls. If all else failed, you could dig beneath the walls. Despite these developments a stout wall remained the best defence an army could have until the modern era.



Defensive technologies gave huge advantages to defending a position. Rams, ladders, and tunnelling can all be seen in this 8th century BCE Assyrian siege

was wicker covered in leather that protected the warrior. Later, Greek hoplites favoured a round wooden shield strengthened by metal. Their shields protected both themselves and the man to the left. To break the line and flee would not only endanger yourself, but the rest of your unit. In a lost battle a heavy shield could slow your retreat, and it was not unheard of for soldiers to fling them aside to better make their escape. For the Spartans this was the ultimate shame, and they were told to either "Come back with your shield, or carried dead upon it." While the shield is a necessary tool, it is not the best defence. It is much easier to survive a battle if you are not even on the field. Archaeology reveals that many towns and cities in the ancient world built strong walls to keep out their enemies. Safe behind a wall, you could pour down arrows on the army milling about beneath you. Even if the enemy came with ladders to scale your walls, you could easily topple them or get more creative – when Alexander attacked Tyre, the defenders heated sand to red-hot and tipped it on the besiegers, as 1st century CE Greek historian Diodorus Siculus recorded: "The sand penetrated through the armour into the shirts, burned the body, and it could not be helped... they died, going mad with horrible pain, in sufferings piteous and unquenchable."

Shields, armour and walls were not the only ways of winning a battle. Deception and fear could be a potent tool in the arsenal. At the battle of Pelusium, the Persian side painted images of the Egyptian gods on their shields and marched with

ANCIENT WAR TECHNOLOGIES

Defining moment
COMPOSITE BOW
PRE-14TH CENTURY BC

The simple – or self – bow consists of just a piece of wood under tension. By laminating layers of horn, wood, and sinew together, the bow can withstand more force and shoot arrows with more power at greater distances. The increased strength allows bows to be made much smaller than simple bows while maintaining the energy delivered to the arrow. A smaller bow is easier to carry into battle, but also gives soldiers mounted on chariots or horses the ability to shoot on the move. It's more complex weapon to build, but ferocious on the battlefield.

Defining moment
TRIREME
8TH CENTURY BCE

The trireme was an oar-powered vessel with three banks of oars, capable of quick manoeuvres and with a ram on its front to sink other ships. Historians doubted the speeds that ancient writers claimed triremes could reach, but reconstructions have proved them to be accurate. The triremes of Ancient Greece allowed some city states to dominate the sea. This allowed for the expansion of Greek colonisation around the Mediterranean. Later, heavier, ships bore even more oars, but the basic sleek design of the ships persisted throughout antiquity and supported the spread of the Roman Empire.

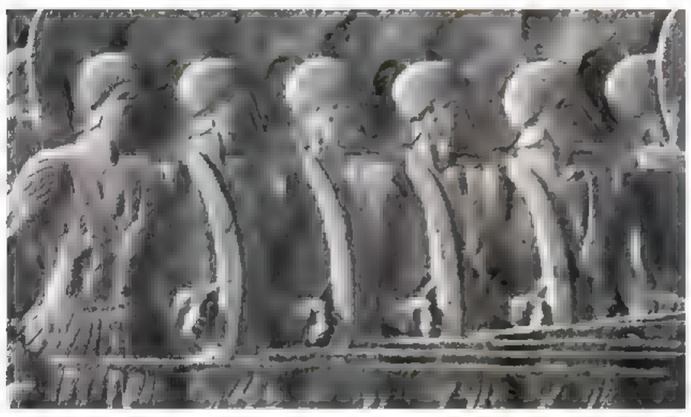
CHARIOTS
First appearing in Mesopotamia, the first chariots were pulled by onagers (wild asses). Slow and unwieldy but useful in supporting the infantry, they developed over centuries into deadly machines that dominated the field of battle.
~2500 BCE

GALLEY
Earlier warships were used to ferry armies from place to place. From the 14th century BCE they developed into weapons themselves, and battles at sea began with crews boarding other vessels and archers on deck.
14TH CENTURY BCE

IRON WEAPONS
Use of iron to make steel weapons ended the Bronze Age, as bronze weapons were neither as strong or as sharp. Steel weapons and armour would dominate for thousands of years.
~1200 BCE

BATTERING RAM
Battering rams were logs slung from mobile wooden structures that were repeatedly pounded against walls and gates to bring them down. Wet hides hung from the sides protected the ram from being set ablaze.
9TH CENTURY BCE

Archery, infantry and cavalry technology were all created in the ancient world and dominated warfare until into the modern age

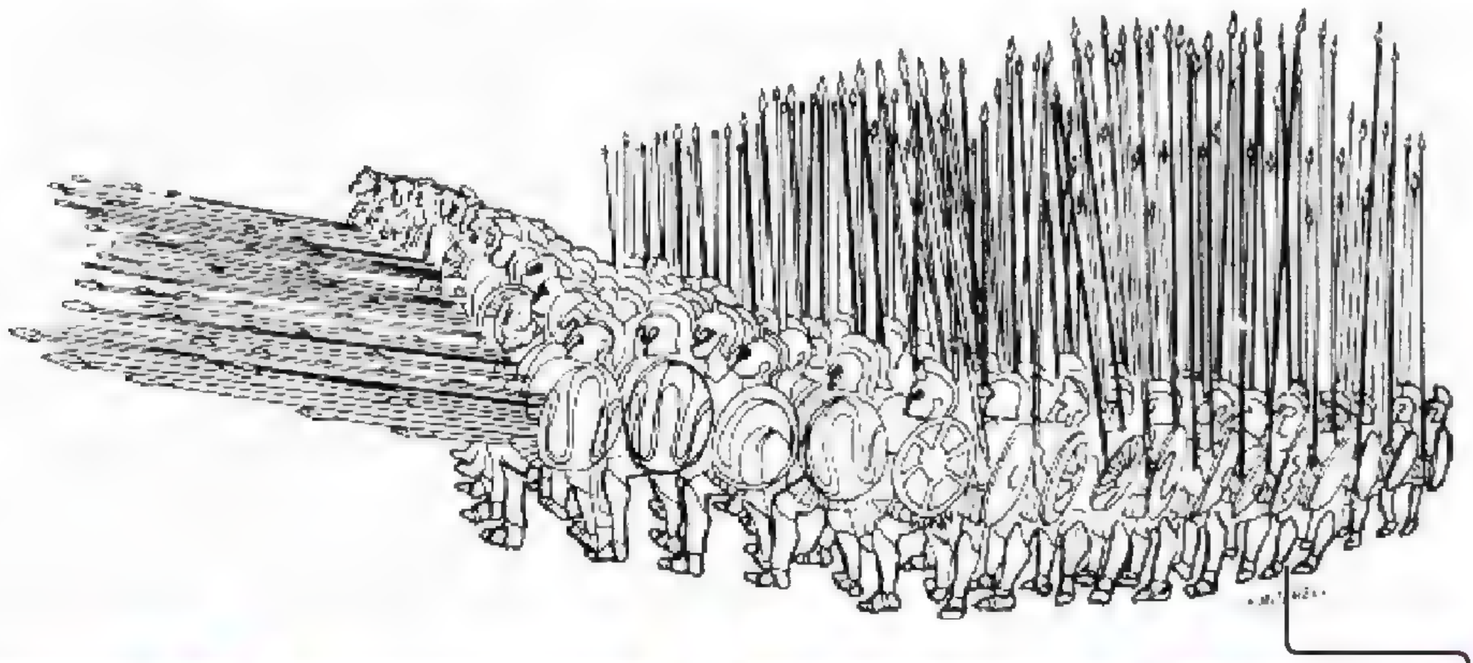


Weaponry improvements drove the development of improved armour, as seen here in Macedonian troops carrying breastplates, shields, and helmets

"THE SAND PENETRATED THROUGH THE ARMOUR INTO THE SHIRTS, BURNED THE BODY, AND IT COULD NOT BE HELPED... THEY DIED, GOING MAD WITH HORRIBLE PAIN"

holy animals – cats, sacred to the Egyptian goddess Bastet – in front of them. The Egyptian soldiers were so scared of offending their gods that they fled, losing the battle.

To confuse his Roman opponents, Hannibal once unleashed thousands of oxen at night with burning wood tied to their horns. The spectacle of what seemed to be a whole army on the move paralysed the Roman force. When the cattle struck the Roman lines their panic scattered the soldiers, giving Hannibal an easy victory.



Defining moment

SARISSA

~358 BCE

King Philip II of Macedon inherited a fractious kingdom and weak army. He transformed his forces through the introduction of the sarissa – a spear up to 6m long made of tough wood. Armed with these long weapons the Macedonian phalanx was able to create a bristling wall of vicious spear tips to attack their enemy with. With this new formation and tactic, Philip was able to impose his leadership on Greece in a number of decisive battles. His son Alexander the Great would conquer a vast empire using this technique as well.

CROSSBOW (CHINESE)
The crossbow offered greater power for its size and better accuracy because it did not require the archer to draw and aim at the same time. The drawback is that crossbows are slower to draw back.
7TH CENTURY BCE

WAR ELEPHANT
Few infantry units or cavalry charges could hold in the face of onslaught by elephants. If an elephant panicked, though, it could be equally destructive to its own side.
6TH CENTURY BCE

BALLISTA
Using twisted ropes allowed the ballista to launch projectiles with a great deal of force. In a siege they could shoot over high walls or even be used to attack walls themselves. Pots of oil could spread fire into a town.
~400 BCE

GLADIUS
The Roman short sword was used more for stabbing than slashing. This allowed Rome to develop the lock-step legions of soldiers standing closely packed with which they conquered their large empire.
3RD CENTURY BCE

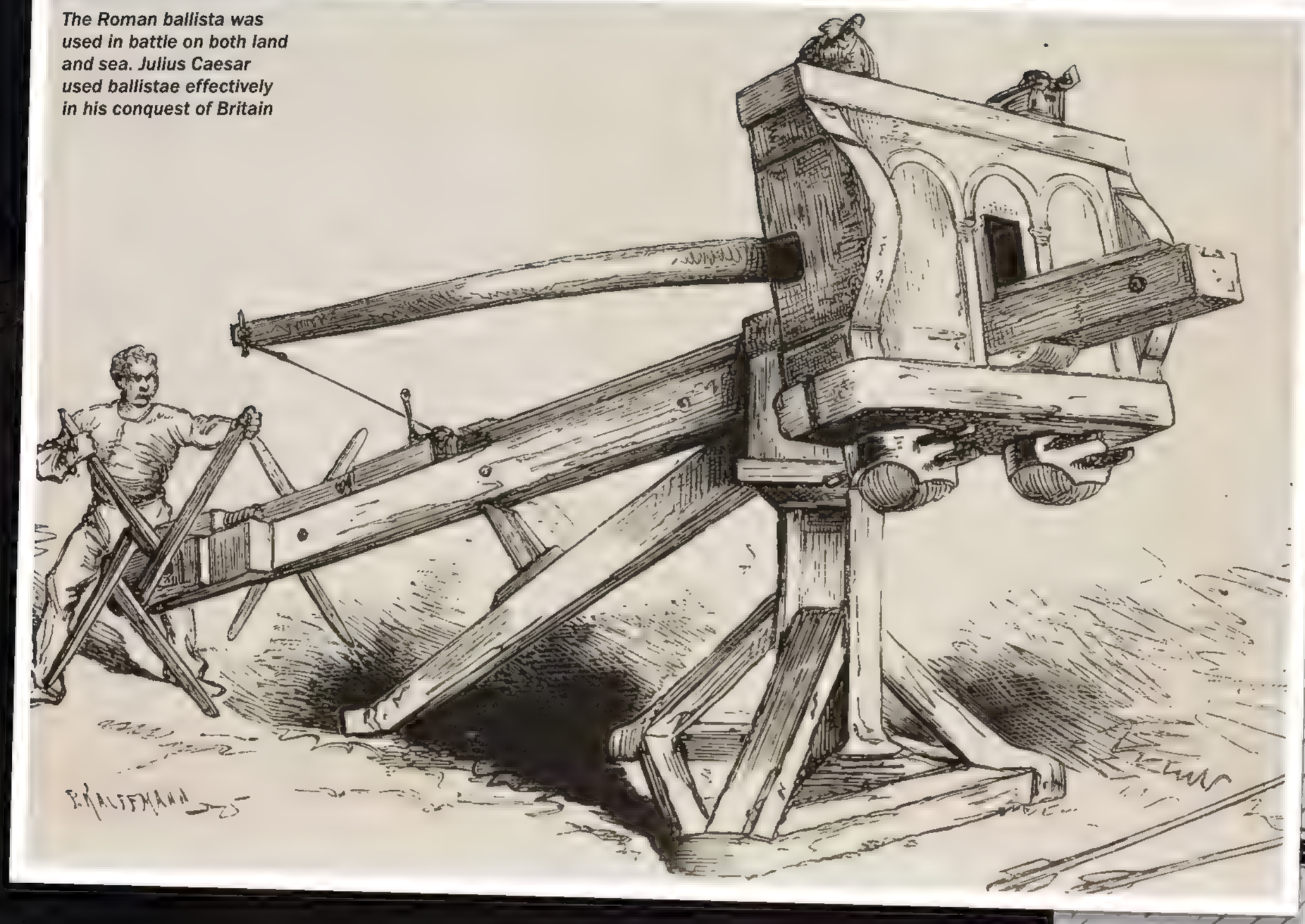
SADDLE AND STIRRUPS
The earliest saddles were simply blankets thrown over a horse's back. With the development of solid saddles, stirrups were invented in China. Stirrups gave riders greater security and paved the way for the cavalry of the Middle Ages.
3RD CENTURY CE

MACEDONIAN SARISSA

4TH CENTURY BCE

Not just a weapon but a way of waging war, the sarissa was a four- to six-metre-long spear wielded by the Macedonian Phalanx, a tightly drilled and well-disciplined square of infantry. The length of the sarissa meant that multiple rows of phalangites – not just the men in front – were able to use their weapons, which they would move in unison. The spear tip was made of bronze and its considerable weight was counterbalanced by a bronze spike located at the opposite end, which could be driven into the ground to receive a sudden enemy charge. As the sarissa needed both hands, the phalangites were protected by a small shield hung from their neck, which covered their left shoulder and profile. Introduced by Philip II of Macedon (359–336 BCE) who turned Macedonia into the leader of the Greek world, this bristling wall of spikes was deployed by his famous son, Alexander the Great (356–323 BCE), to conquer many lands and create the greatest empire the ancient world had yet seen.

"THE SPEAR TIP OF THE SARISSA WAS MADE OF BRONZE, AND ITS CONSIDERABLE WEIGHT WAS COUNTERBALANCED BY A BRONZE SPIKE LOCATED AT THE OPPOSITE END, WHICH COULD BE DRIVEN INTO THE GROUND TO RECEIVE A SUDDEN ENEMY CHARGE"



The Roman ballista was used in battle on both land and sea. Julius Caesar used ballistae effectively in his conquest of Britain

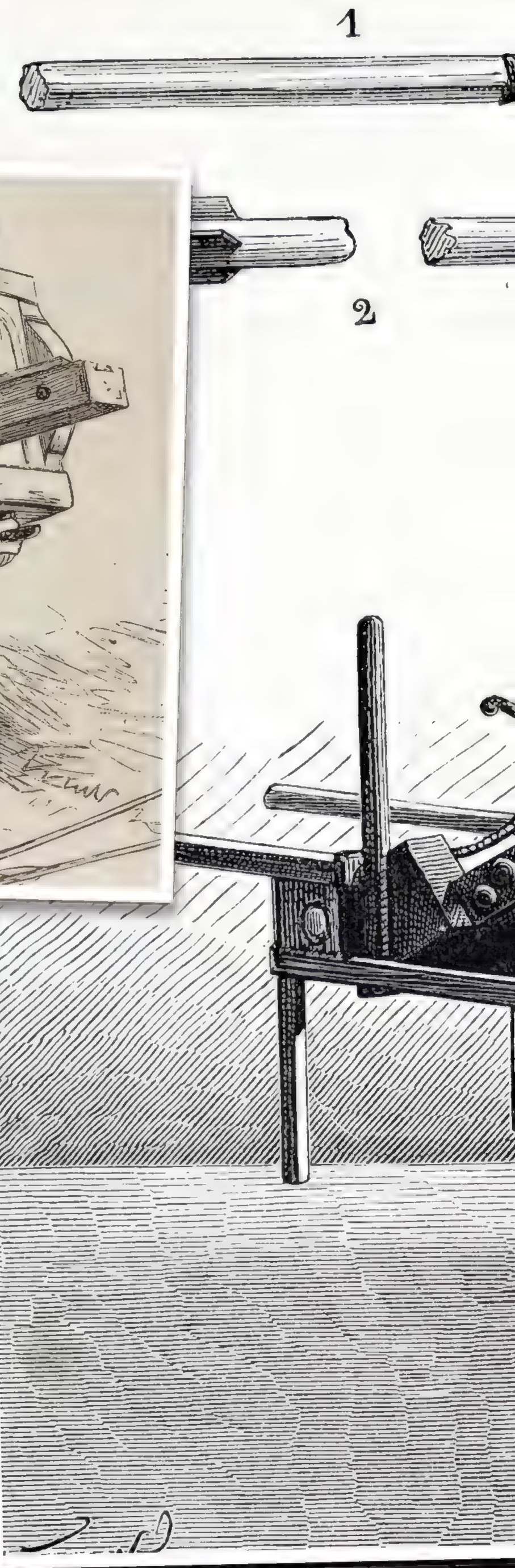
ROMAN BALLISTA

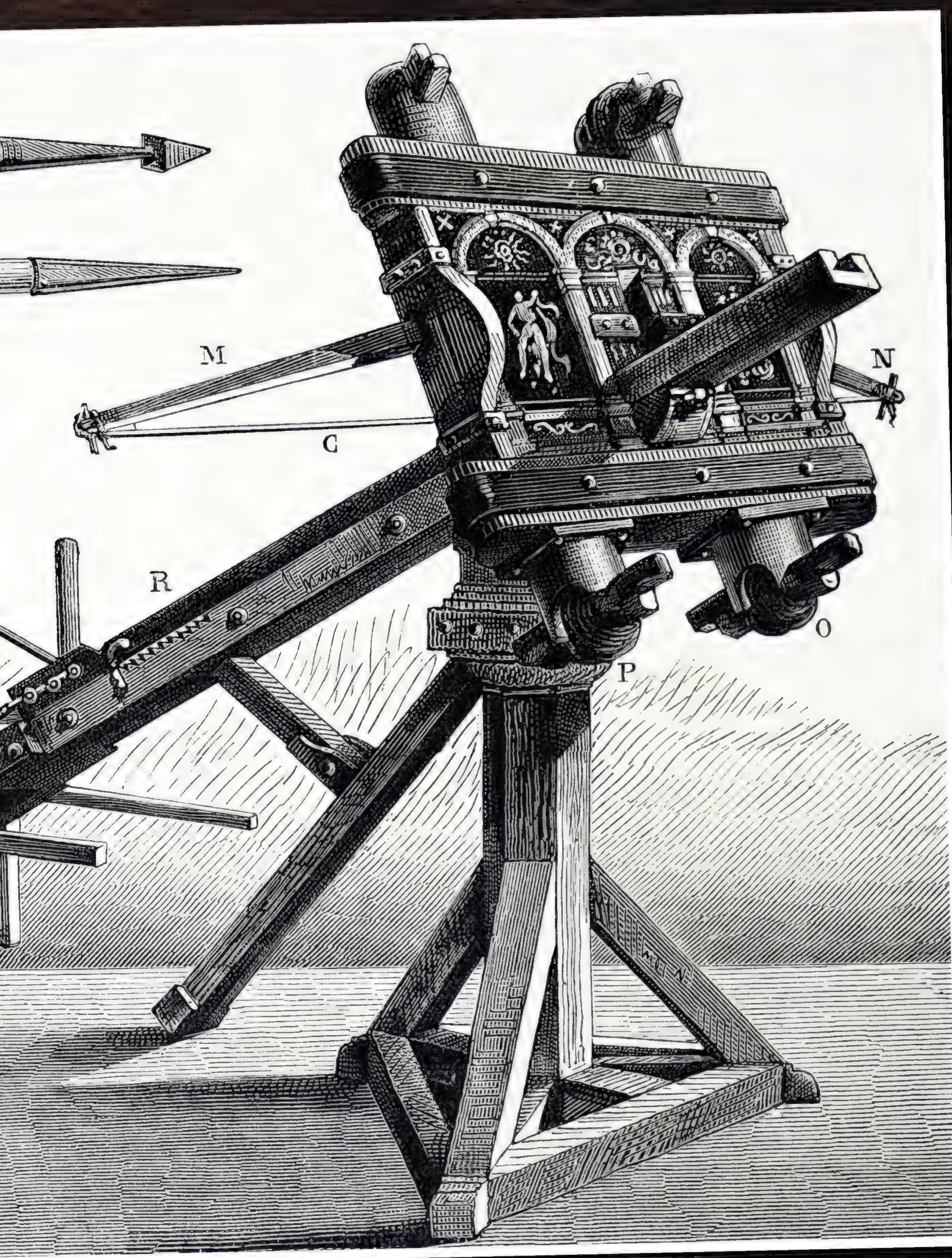
1ST CENTURY BCE

Using the same torsion principle as the crossbow, the ballista was first developed as a siege weapon in ancient Greece, but it came of age during the time of the late Roman Republic and early Roman Empire.

The Roman ballista used winches and a 'claw' on rope to draw the bowstring back further than was previously possible. Animal sinew around the bow arms acted as springs to increase the torsion. When released, this energy was transferred to the stone ball or wooden bolt, firing it with much greater force and distance than earlier models.

Ballistae were used to great effect by Julius Caesar (100–44 BCE) during his conquests of Gaul (58–50 BCE) and Britain (55–54 BCE).

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PERSIAN WAR ELEPHANT

6TH CENTURY BCE

As damaging psychologically as they were to those caught underfoot, in the earliest accounts – from 6th century BCE India – war elephants were ridden as mounts, like horses. The practice spread to the Persian Empire where they were recorded in battle against the Greeks at Gaugamela (331 BCE), deployed at the front of the Persian line to lead the charge. The elephant's rider sat on the neck, while soldiers on a platform on the elephant's back would fight with bows and javelins. The elephant itself would be protected with a thin sheet of mail or plate armour.

Often spooked by the clamour of battle, the elephant could just as easily blunder back towards its own lines and wreak untold havoc.

ROMAN CONTRAVALLATION

4TH CENTURY BCE

Circumvallation, by which a besieging army surrounds the siege with an unbroken line of earthworks for protection, was first reported being used by the Spartans in 492 BCE. Contravallation is one better. It is the act of surrounding the first line of defences – which face inward toward the siege – with a second line of defences that face outwards, in order to protect the besieging army from enemy reinforcements.

Unsurprisingly, a feat this ambitious required Roman engineering. At the Siege of Alesia (52 BCE), Julius Caesar (100–44 BCE) surrounded the Gaulish holdout with a line of circumvallation and contravallation – earth banks and wooden stockades with gates and towers – to enable a Roman army of no more than 75,000 men to defeat 80,000 Gaulish defenders and a relief force of 248,000.

"CONTRAVALLATION IS THE ACT OF SURROUNDING THE FIRST LINE OF DEFENCES WITH A SECOND LINE FACING OUTWARDS IN ORDER TO PROTECT THE BESIEGING ARMY FROM ENEMY REINFORCEMENTS"

Great Battles

BATTLE OF KADESH

Two powerful ancient empires – and their chariot technologies – clash for control in the first battle with recorded tactics

KADESH, MODERN SYRIA MAY 1274 BCE

WORDS BEN GAZUR

Weeks on the march had brought the four divisions of the Egyptian army within striking distance of their goal. A camp was set up within sight of the walls of Kadesh. Pharaoh Ramesses II had every reason to believe that his conquest would be quick, total, and unopposed. By the end of the morning though, armies were scattered, swords and shields thrown down in the dust, and the Egyptian leader was in a battle for his life.

The Battle of Kadesh (1274 BCE) is the earliest battle for which historians have records of the numbers of men involved, the types of troops deployed, their movements and the outcome. Remarkably for such an early conflict, written sources from both sides still exist, although they can throw the outcome into some doubt. Here we will see how two mighty empires brought together forces armed with the most advanced weaponry of the age in a battle that shaped history.

"THE BATTLE OF KADESH IS THE EARLIEST BATTLE FOR WHICH HISTORIANS HAVE RECORDS OF THE NUMBERS OF MEN INVOLVED"

OPPOSING FORCES

EGYPT

LEADERS:
Commander: Pharaoh Ramesses II
Grand Vizier Paser
Prince Amunherkhepeshef
Prince Ramesses
Prince Khaemweset
Prince Pareherwenemef
OVERALL:
16,000 infantry
2,000 two-man chariots

VS

HITTITE EMPIRE

LEADERS:
Commander: King Muwatalli II
Prince Hattusili
Mittanamuwash of Pitassa
Masturish of Seha River Land
Piyama-Inarash of Wilusa
Sahurunuwash of Carchemish
Sattuara of Mitanni
Niqmepa of Ugarit
Talmi-Sarruma of Aleppo
Niqmaddu of Kadesh
OVERALL:
Up to 40,000 infantry
~3,000 three-man chariots

Getty

Ramses II in a chariot with a bow and arrow at the Battle of Kadesh

Moving frontiers

Most people think of Ancient Egypt as a stable kingdom that existed unchanged since the dawn of time. In fact, borders fluctuated as new nations rose and fell around it.

Enemies of the pharaohs attacked Egypt both internally and externally. In the 18th century BCE, the Hyskos invaded from Palestine and took control of the country, bringing the Middle Kingdom period to an end. Driving the Hyskos out left the New Kingdom of Egypt with a desire to create a buffer zone along its northern border to be secure from future incursions. Peace with its neighbours could not last long.

From around 1800 BCE in Anatolia, modern Turkey, the Hittite civilisation began to expand. To defend their kingdom from invasion the Hittites attacked outwards. Some lands were absorbed directly into their empire, while in others they placed a ruler loyal to them on the throne. With the Hittites probing ever southward and the Egyptians moving into the rich lands to the north, it became inevitable that war would result.

Hittite sources suggest that there had been a treaty between the two empires. Hittite tablets record, "The people of Hatti [The Hittites] and Egypt were put under oath by the Storm god," an oath not to attack the other. It seems that the Hittites later broke this treaty for opportunistic reasons. "The men of Hatti proceeded to get the upper hand, the men of Hatti thereby transgressed the oath of the gods at once. My father [The Hittite king is speaking] sent infantry and chariotry, and they attacked the borderland of Egypt."

The land both empires fought for was the area around the city of Amurru, which changed hands many times during decades of conflict. Part of this territory was the town of Kadesh.

Build-up to war

"When Muwatalli became king the people of Amurru rebelled against him and let him know this: 'We used to be loyal subjects, but we are your subjects no longer!' and they decided to support the king of Egypt", reveals a Hittite tablet. While Amurru had flipped its allegiance a number of times, the new Hittite king Muwatalli II would not allow it to return to the Egyptians this time. Losing Amurru would leave the enemy far too close for comfort. Judging the Hittite capital at Hattusa to be too far from the sites of potential warfare, Muwatalli moved the seat of government to Tarhuntassa in the south. Here, he gathered forces from throughout his domains.

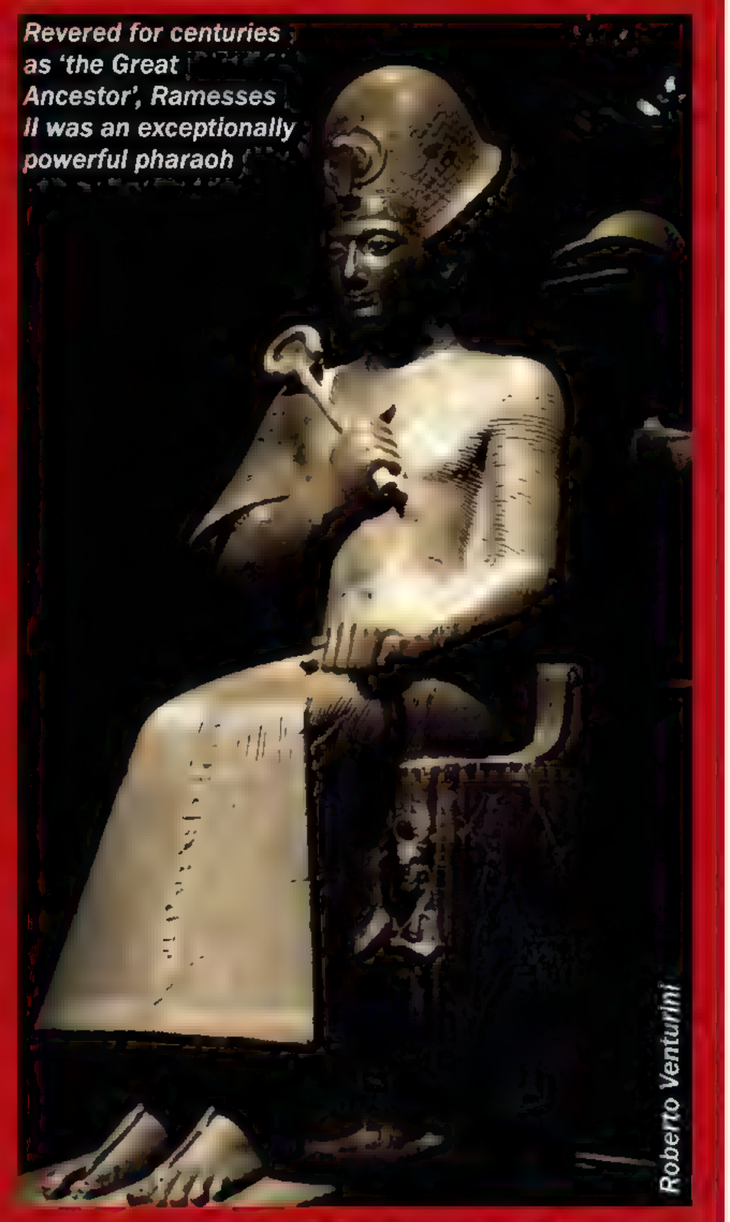
The Hittites did not always rule areas of their domain directly. Many neighbours signed treaties with the Hittites. Rimisharrinaa, king of Aleppo, was bound to Muwatalli by such an agreement: "the Great King of Hatti... will be ally of the king of Aleppo. The gods of Hatti and the gods of Aleppo will be witnesses and guarantors of this treaty." The land of Kizwadna had a treaty that demanded, "Its king will send one hundred horses equipped with chariots and a thousand foot soldiers to the Hittites, who will provide for them." In all, 19 allies of the Hittite king are recorded as fighting alongside him at Kadesh. When the Hittite army marched it was not just a single nation on the move; it was a mobile empire. Egyptian sources are critical of the way in which Muwatalli brought his armies together, claiming it was done by mercenary means. "He left not silver nor gold in his land, but he plundered it of all its possessions and gave to every country, in order to bring them with him to battle." In all, Egyptian sources say, Muwatalli gathered a force of 37,000 infantry and 3,000 chariots for his campaign.

The Hittites were not the only ones arming for battle. In Egypt, Ramesses II had become pharaoh. As a young man he joined in his father's campaigns against the Hittites; wars that gave little glory to the Egyptians. Ramesses II required a military victory to secure his throne and gain a reputation as a fearsome warrior. Muwatalli had moved his capital south to be closer to the action, and Ramesses founded a city high in the Nile delta, Pi-Ramesses, so that he could be close to any battlefront.

At Pi-Ramesses the pharaoh called together his troops. The Egyptian army was much less diverse than the Hittite. Of the troops Ramesses called up, most were Egyptians, although Nubians were included in the forces, as were the Sherden – apparently raiders from the sea. A monument records that it was Ramesses II who defeated the Sherden and captured many of them. That they are listed among his forces at Kadesh suggests Ramesses thought them good

"WHILE AMURRU HAD FLIPPED ITS ALLEIGANCE A NUMBER OF TIMES, THE NEW HITTITE KING MUWATALLI II WOULD NOT ALLOW IT TO RETURN TO THE EGYPTIANS THIS TIME"

Egyptian pharaohs were often shown riding a chariot in war. Here Tutankhamun scatters his foes



Revered for centuries as 'the Great Ancestor', Ramesses II was an exceptionally powerful pharaoh

Roberto Venturini

RAMESSES II

RAMESSES THE GREAT EARNED HIS TITLE THROUGH HIS EXPLOITS ON THE BATTLEFIELD OF KADESH

As a prince, Ramesses took part in his father Seti's battles in Canaan and against the Hittites. These campaigns included the Egyptian capture of Kadesh. However, Kadesh and Amurru soon reverted to the Hittite Empire, and it was not until Ramesses became Pharaoh that the Egyptians would once again attempt to capture it.

With his experience of fighting Hittites, it would have been clear that in battle, Egyptian chariots had the advantage of speed and manoeuvrability. The Egyptian chariot carried just two men – a driver and a soldier – as opposed to the Hittite chariot, which held three men. While it was easier to move infantry units the hundreds of miles between Egypt and Kadesh, the chariots were understood to be the key to victory. Pharaohs were often shown riding a chariot, such was its strategic importance.

The chariot on its own was not much of a weapon. Expensive to build and tricky to maintain, they were valuable to the Egyptian army as mobile platforms for archers. The composite bow (made by laminating various materials together) used at the time was still a cumbersome weapon. Shooting it from horseback with any great accuracy, or at all, was extremely difficult. Shooting from a chariot designed to offer a smooth ride even at speed gave archers the range of motion and space to operate. A chariot offered an archer the chance to rapidly approach their enemy, strike them, and while still shooting, retreat. The opponent, by contrast, had a moving target to try and hit.

By combining chariot charges with archery, the Egyptians could skilfully counter the Hittite use of slower but more heavily manned chariots. The Hittite chariot was best used to slam into infantry and disrupt battle formations. Once on top of the enemy, the Hittite charioteers could deal out enormous damage with their spears, as seen in the first stages of the Battle of Kadesh; when the Hittites drove a whole division of infantry to flight, they could be a key tool in battle.

One of the advantages of chariots was that they could so easily outdistance the infantry. A pair of horses could soon leave behind men on foot. But this was also a danger. The Hittite chariot corps left its infantry troops miles behind it. Had the Egyptians been arrayed for battle they might have stopped the charge and simply pulled down the Hittite charioteers. As it was, the Hittites became entangled in the Egyptian camp with no infantry support. Here, the Egyptian infantry were able to fight back and Ramesses was able to regroup his own charioteers into a rapid counter-offensive.

The swifter Egyptian chariots, with their fresh horses, were able to gallop around the Hittite chariots and aim repeated arrows at them. The tired Hittite horses could not escape from their nimbler foes. Having mostly close-quarters weapons at their disposal, Hittite charioteers could not strike back at their opponents and were forced to abandon the fight.

Being considerably lighter than the Hittite chariots the Egyptian were able to make rapid responses to the changing conditions on the field. After seeing the initial attack on the camp off Ramesses turned his chariot unit around to fend off another chariot charge by the Hittites. He was also able to call up a reserve unit of archers to create panic among the enemy and break their momentum. The tactical use of mixed troop types was what allowed Ramesses to turn a potentially catastrophic ambush and defeat into a victory long remembered by the Egyptians.

fighters and that they were now loyal to him.

The Egyptian force consisted of four divisions named after gods: Amun, Re, Seth and Ptah. Sources also describe a force of Nearin warriors, possibly Moabite fighters, who were sent north along the coast. Little is known about this unit, but they would prove crucial in the battle to come. Ramesses led the Amun division, taking four of his sons along with him to give them experience of warfare. Each division consisted of around 4,000 infantry accompanied by about 500 chariots. These 2,000 chariots would be decisive.

Chariots of war

At first glance a chariot can seem an odd choice for a battle vehicle. Made of wood and other organic materials, they can appear flimsy and not able to stand up to the rigours of a fight. While charging horses might give you a shocking impact on enemy troops, the open nature of the ancient chariot meant that riders could easily be pulled down and slain. You might ask, why bother carting chariots across hundreds of miles of difficult terrain then?

Despite appearances, ancient chariots were highly sophisticated pieces of military equipment. The best-preserved chariots from the ancient world were found in the tomb of Tutankhamun, and date to around 60 years before the battle of Kadesh. These chariots were light, fast and manoeuvrable. The flexible wooden rims of the wheels gave stability to the riders on uneven ground. Animal fat greased the bearings, allowing for high speeds and long use. The spokes of the wheels used elastic wood, which dampened vibrations. All this gave the Egyptian two-man chariot a remarkably smooth ride, even at speeds of up to 25mph. From this steady platform, Egyptians were able to shoot arrows effectively even while charging and use short spears for close-quarters fighting.

By contrast, the Hittites favoured a three-man chariot. Heavier and less easy to turn, these chariots would be used to smash opponents and drive them from the field.

In carved depictions of the Hittite chariots, one soldier is controlling the horses, another holds a shield to protect his companions, and another wields a long spear. For Hittite chariots to be effective they needed to be right next to their enemy.

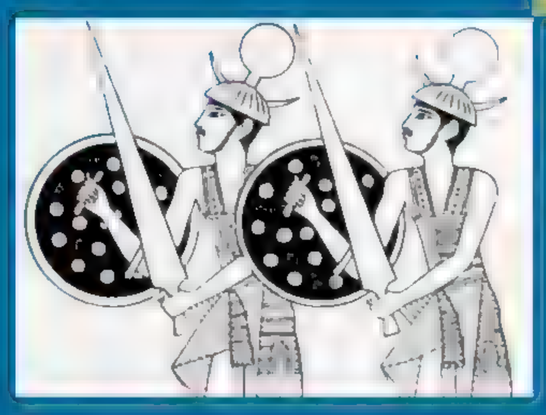
EGYPTIANS

INFANTRY

Egyptian infantry went into battle lightly armoured, with light shields, spears, swords or axes. They were the backbone of the battlefield.

CHARIOTS

Used to harass the enemy by darting in, shooting arrows and dodging away. Devastating to an enemy in retreat or infantry with no cover.



SHERDEN

A captive sea-people used by Ramesses II as a personal body guard. Held the Egyptian camp against attack and ensured the safety of the royal family.

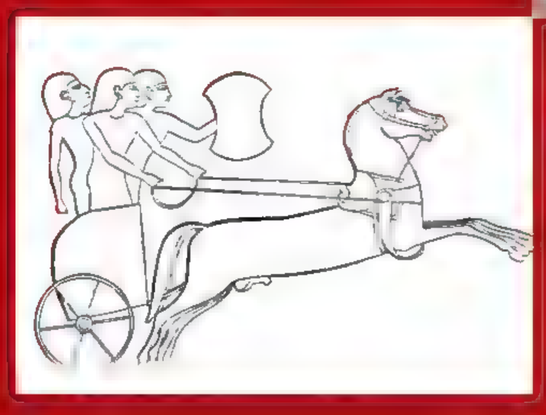
HITTITES

MUWATALLI II

King of the Hittite Empire and commander of the army. Stationed in the Hittite camp with a large number of infantry. Out of contact for most of the battle.

INFANTRY

Hittite infantry carried spears and curved swords into battle. At Kadesh the infantry did not join the battle, instead remaining at the camp.



CHARIOTS

The Hittite chariot carried three men into battle. Charioteers used spears to strike down at the enemy when they got close.

Great Battles

BATTLE OF KADESH

01 DECEIT AND DECEPTION

With the Egyptian force marching separately for logistical reasons, Amun Division, commanded by Pharaoh, is the first to reach Kadesh. Encountering two Bedouin who trick them into believing that the Hittites are still on the march, they cross the Orontes River and set up camp northwest of the town. Then two captured Hittite soldiers reveal that the enemy is in fact gathered in force just the other side of the river.

"THE HITTITE SURPRISE ATTACK COULD WELL HAVE BEEN THE EGYPTIANS' UNDOING, EXCEPT THAT THEY HAD A SURPRISE OF THEIR OWN – ONE NOT EVEN THEY WERE EXPECTING..."

02 RE DIVISION FAILS TO REINFORCE

Grand Vizier Paser is sent to summon Re Division to Pharaoh's aid. They are six miles away and on the wrong side of the river. Advancing at top speed, they are strung out and unready for battle when the heavy three-man Hittite chariots smash into them. Stragglers, in the faster Egyptian two-man chariots, try frantically to escape in the direction of Pharaoh's camp to support their hard-pressed ruler.

03 THE PERILS OF PLUNDER

The onrushing Hittite chariots break the shield wall around the Egyptian camp. Pharaoh will later recall that at one point he is facing the enemy alone, his usual company of protective officers scattered or dead. However, the sudden onslaught on the Egyptian camp proves the Hittites' undoing. Stopping to loot the rich possessions of the Egyptian fallen, their heavy, lumbering chariots are boxed in to the small camp and its rough, corpse-strewn ground. The faster, more manoeuverable Egyptian chariots wheel to face the enemy again; the long-ranged Egyptian bows singing with a counter-attack that the Hittites don't have the shooting power to answer effectively.

04 CLASH OF CHARIOTS

The primary Hittite force flees before the rallying Egyptians. The Hittite king forms a chariot reserve, with the aim of sending them to attack the Egyptian camp once again, while the Egyptian force has been drawn away, busy routing the initial Hittite looters. The ponderous chariots of the Hittites show to advantage here: the heavier vehicles are capable of fording the river, allowing the chariot reserve to advance on the undefended Egyptian camp with surprising speed.

05 SURPRISE ATTACK

The Hittite surprise attack could well have been the Egyptians' undoing, except that they had a surprise of their own – one not even they were expecting. The Egyptians had sent a force of Nearin warriors via a different, coastal route to secure a port, which they apparently accomplished quickly and easily, because as the Hittite chariot reserve advances on the Egyptian camp, the Nearin appear unlooked-for and rush into the fray, unleashing a hail of arrows and driving the Hittites back to the river.

EGYPTIANS

HITTITES

Map: Rocio Espin

In this wall painting from Abu Simbel, two-man Egyptian chariots are shown scattering the three-men chariots of the Hittites at Kadesh

Before the battle

As the Egyptian force moved north they were forced to stretch out the line of march. Each of the four divisions had to travel separately because of scarcity of provisions and water. If the whole army moved as one the land could not have supported them. This left them vulnerable to ambush. To provide advanced warning of this, the Egyptians sent out scouts to monitor the land around them.

Arriving on the plain of Kadesh, the Egyptian scouts encountered two local Bedouin. When brought before Ramesses, they revealed that the Hittite force was some 120 miles away, near Aleppo. They also said that Muwatalli was afraid to face the Pharaoh in battle. Pleased by this intelligence, Ramesses led the Amun division across the river Orontes, setting up a camp to the northwest of Kadesh to await the arrival of the other three Egyptian divisions.

While in camp, Egyptian scouts brought in two Hittite soldiers. Egyptian friezes show the two enemy captives being beaten with clubs. This treatment persuaded the Hittites to reveal all. The Bedouin taken earlier had been spreading fake news on behalf of the Hittites. Instead of being 100 miles away, the Hittite force was gathered nearby on the other side of the river. "They have their weapons of war at the ready. They are more numerous than the grains of sand on the beach," the Hittite prisoners said.

Ramesses called a war council of his princes and high officers. Egyptian texts show him raving at the incompetence of his generals in not knowing where the enemy was. Vastly outnumbered by the Hittites and at risk of being completely annihilated, Ramesses sent his Grand Vizier to hurry the other Egyptian divisions to arrive at Kadesh.

The Battle of Kadesh

The nearest Egyptian force was the Re division, six miles away and on the wrong side of the river. We must imagine the effect of Grand Vizier Paser racing into their camp in the early morning with the news of their Pharaoh being left so exposed. As trumpets blared out the orders to march at top speed, the Vizier sped from the camp in search of the other divisions.

The Re division crossed the plain of Kadesh as quickly as it could to reach the Egyptian camp, but this left them strung out in a thin line and unready for battle. Seeing this weakness, the Hittites sent out their force of chariots. Caught in the open field, the Re division was smashed beneath the wheels of the heavy Hittite chariots. Shields and weapons were tossed away to make escape easier in the confusion. With Re dispersed, the Hittites tried to run down those soldiers straggling towards the Egyptian camp. The Egyptian chariots of the shattered division could only try to beat them to the camp.

Inside the camp, Ramesses watched as the Hittite chariots broke the shield wall erected by the Amun soldiers to protect their Pharaoh. The attack was sudden and shocking, not at all like the stately battles of forces approaching openly in the field. The only advantage the Egyptians

A relief at Abu Simbel shows Ramesses II trampling one Hittite enemy while slaying another at the Battle of Kadesh

had was that their crushed belongings and the remnants of the camp slowed the Hittite advance. The heavy chariots could not manoeuvre in the close quarters. Some Hittites were pulled down and killed, but many more tore through the camp. Ramesses later described his own situation at that moment. "No officer was with me, no charioteer, no soldier of the army, no shield-bearer."

The Hittite attack on the Egyptian camp was halted by the Hittites themselves as they stopped to plunder the belongings of the army. This pause gave time for the Egyptian light chariots to form up and counter-attack. The Egyptian force was able to shoot waves of arrows in an accurate and deadly hail on the Hittites. The excellent suspension of their vehicles gave the Egyptian archers the perfect platform to take aim from, even as their horses plunged into the fight. In a confused mass the Hittites attempted to close with the Egyptians. The Hittite bows lacked the range of the Egyptian ones, and their heavy chariots could not keep up with the Egyptians wheeling about them. Unable to close with their enemy and in danger of being destroyed, the Hittites fled.

This was when Ramesses led his chariots to victory. The Hittite chariot horses were tired from the battle, but most of the Egyptian force was fresh. They quickly outpaced their opponents and hit the slow-moving targets with more arrows. The Hittites whipped their horses towards the river to seek safety on the other side.

For the first time since the battle started, King Muwatalli acted. He had many more infantry than the Egyptians, but they would be of little use in a chariot battle. He called together the elite warriors of his force, including his brothers, allied kings and generals. Forming a reserve of chariots, he sent them into battle – not to support his other chariots, but to attack the Egyptian camp again while all their mobile force was away chasing the retreating Hittites.

"THOSE WHO WERE CAUGHT BY THE EGYPTIAN INFANTRY WERE SLAUGHTERED, THEIR HANDS CUT OFF TO MAKE A TALLY OF THE HITTITE DEAD"

Fording the river, this detachment of royal fighters seemed set to capture the Egyptian camp. It was then that the Nearin division, sent up the coast away from the main Egyptian army, appeared on the field and unleashed a withering rain of arrows. The elites in the Hittite chariots panicked and turned around to flee. By now Ramesses had driven off the other Hittite chariot force and joined this fight. The Hittites abandoned their chariots and plunged into the river to seek the safety of their camp. Those who were caught by Egyptian infantry were slaughtered, their hands cut off to make a tally of the Hittite dead. Of those who reached the river many drowned. In one Egyptian carving the Prince of Aleppo is shown being shaken by his heels to get the water out of him. The total number of Hittite dead is not known, but two of Muwatalli's brothers died, along with two of his shield bearers, his secretary, the chief of his bodyguard and other army leaders. The Hittite infantry never left their camp.

Aftermath

The Egyptians recorded the battle of Kadesh as a supreme victory for themselves. Historians, though, have taken a more nuanced look. In the immediate aftermath of the battle the Egyptians commanded the field, as the Hittite chariot strength had been entirely wiped out, yet the Hittites outnumbered the remaining Egyptians even when the Ptah and Seth divisions finally arrived. The Egyptian sources say that Muwatalli begged them for peace, but it seems unlikely. The Hittites did not even give up the town of Kadesh to the Egyptians. Yet Ramesses had achieved what he came for – he was returning to Egypt as a military hero.

The Hittites, however, counted the entire campaign as a success. Hittite sources, though much rarer than the Egyptian ones, do not mention Kadesh as a major battle. Instead they talk of the struggle to retake Amurru, which they did after the Battle of Kadesh. They installed a puppet king in the city and ruled it until the Hittite Empire fell.

13 years after Kadesh, and with further skirmishes in between, Ramesses again attacked the Hittites. At the same time the Assyrians lead an assault against them, which seems to have made the Hittites more amenable to a peace treaty. The resulting Egypt-Hittite pact is the earliest surviving treaty that we have both sides' copies of. Many conditions are agreed on "so that they also shall be at peace and brotherhood for ever; there shall arise no hostility between them for ever." A copy is prominently displayed at the United Nations today.

THE ROMAN WAR MACHINE

Discover how the organisation, weapons and training techniques of Rome's legions conquered the world

The Roman Empire dominated global battlefields for centuries, invading huge swathes of Europe and making significant inroads into both Africa and Asia Minor. Pax Romana, Roman peace, lasted from approximately 27 BCE to 180 CE, when the majority of Europe was under long-term Roman administration. During this time the barbarian hordes were quelled and the Empire enjoyed relative tranquillity – Roman citizens had their formidable army to thank for this. Expertly trained and impeccably organised, Roman soldiers were among the best armed soldiers the world had ever seen. The Roman war machine outwitted its barbarian opponents by using expert battle tactics and perfectly engineered weapons and armour.

Whether they were fighting on the sands of Egypt at the height of summer, or the cold icy wastes of northern Europe in winter, the legions had the tools and dedication for the job. The hierarchy and structure of the army was rigidly ordered, from the legate generals at the top, all the way down to the munifex legionaries at the bottom.

The Romans were among the first to use siege weapons and, unlike other civilisations of the age, soldiers were given full-time pay. In fact, a soldier was one of the finest careers in the Empire. A legionary was paid 225 denarii for one year's service and even earned a pension and sometimes a portion of land after they retired, which was usually after 25 years.

On the battlefield soldiers worked together as one fighting entity, calling upon several deadly combat techniques to unleash on the enemy with devastating effect. However, perhaps the most remarkable aspect of the army was its transport and communication systems. Managing the logistics and administration of such a huge army in ancient times was a tricky business, so it was a phenomenal achievement that Roman generals kept their military machine so well oiled for such a long time.

"WHETHER THEY WERE FIGHTING ON THE SANDS OF EGYPT AT THE HEIGHT OF SUMMER, OR THE COLD ICY WASTES OF NORTHERN EUROPE IN WINTER, THE LEGIONS HAD THE TOOLS AND DEDICATION FOR THE JOB"

Collingwood Historic Art

TRAINING

HOW THE ROMAN ARMY WAS PUT THROUGH ITS PACES AS IT PREPARED FOR BATTLE

To be selected, a recruit legionary would have to be at least 1.8 metres (5ft 10 inches) tall, be physically fit and have good eyesight. He would usually be allowed to begin his military training at the age of 18, although this could be decreased when the Empire was at war. After swearing an oath of allegiance called a 'sacrementum' to the emperor, he would begin his training. A huge emphasis was placed on marching and legions would travel 20 Roman miles (18.4 miles/29.6 km) a day, with a full load of equipment on their backs. There would also be repeated practise of formations and strategies to use in battles. Weapons training was a daily exercise, as was the construction of ramparts and fortifications in case of a surprise barbarian ambush on a Roman camp.

TRAINING ARENAS
In harsh winters, training would be moved indoors to purpose-built arenas within the camps, so drills could be carried out 365 days of the year whatever the weather.

COMBAT TRAINING
Wooden swords and shields were used in training drills. Here the legionaries would practise their combat technique and hone their skills, ready to do battle with the barbarian hordes.

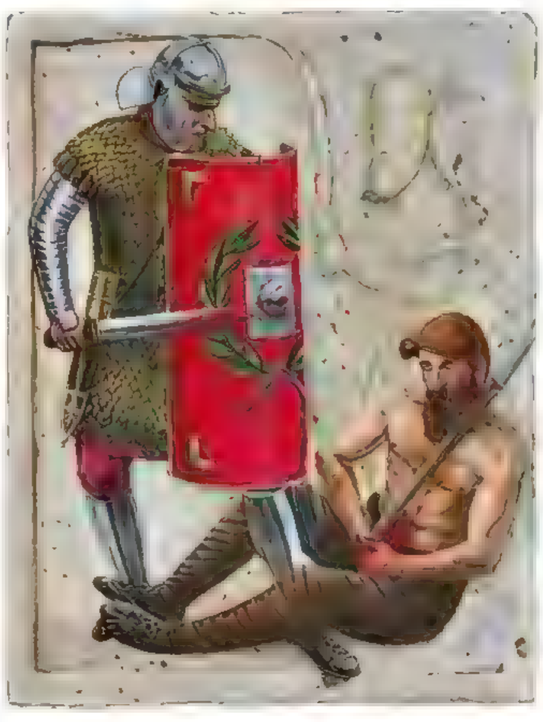
COMBAT TECHNIQUE

THE HAND-TO-HAND EXPERTISE OF A ROMAN LEGIONARY

Legionary fighting styles involved a mixture of sword and shield tactics. Barbarians from tribes such as the Visigoths, Ostrogoths, Gauls and Vandals would often carry two-handed broadswords that could do major damage with a single blow.

To combat this threat, the Roman soldier would block the oncoming enemy with his shield and force him to reel backwards or even to the ground. From here, the legionary could use his sword to deliver quick cut-and-thrust strikes before the enemy could recover.

The gladius was much more nimble than barbarian broadswords and even if the legionary were disarmed, he could use his shield as a blunt weapon. Alternatively he could reach for his secondary weapon: a short concealed dagger known as a pugio.

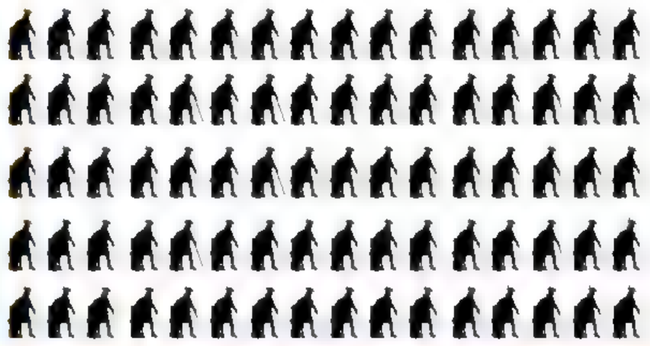


DISCIPLINE

If a soldier didn't perform his tasks well and failed his assignments, there would be strict punishments. These could range from a decrease in rations, to corporal punishment.

1 CONTUBERNIUM = 8 MEN

10 CONTUBERNIA = 1 CENTURY = 80 MEN



6 CENTURIES = 1 COHORT = 480 MEN

10 COHORTS + 120 HORSEMEN = 1 LEGION = 4,920 MEN

4,920

(PLUS ADDITIONAL AUXILIARY TROOPS)

HIERARCHY & STRUCTURE

ORGANISATION WAS OF THE UTMOST IMPORTANCE TO THE WORLD'S FIRST-EVER PROFESSIONAL FIGHTING FORCE

The first division of the Roman army was the Manipular Legion, which was formed shortly after the city of Rome was founded in 753 BCE. Containing major influences from the phalanx tactics of the era, this initial army helped the Romans defeat rival settlements on the peninsula, such as the Etruscans, the Samnites, as well as Greek and Macedonian forces that had come across the Adriatic and Ionian Seas to the east. At this time, the soldiers formed more of a militia than an army per se but this was all to change in 107 BCE with the Marian Reforms. Instigated by general and statesman Gaius Marius, the reorganisation turned the army into a structured, professional force. There was now a standard pay for the new full-time legionary and unlike before the army didn't disband after every campaign. Men were now hired from all across Italy and the number of troops swelled considerably. This was the birth of the Roman war machine.

With the new structure came a new type of hierarchy. At the very top were the generals, known as legates, who would command a legion of thousands of men. The units would then be divided up further into cohorts of several hundred men and finally 80-man divisions known as centuries that would be controlled by a centurion who received around 18 times more pay than the standard legionary.

The Roman Republic became an empire in 27 BCE when Augustus assumed complete control of the senate. Within the new Empire, fresh tactics and formations began to appear. Armoured cavalry units became popular and provided a whole new type of warfare on the ancient battlefield. Shortly after cavalry, siege weapons such as the onager and ballista were used in some of the world's first-ever sieges.

AUXILIARY STRUCTURE

THE INFLUX OF MERCENARY FIGHTERS

As the Empire expanded, it required more and more manpower to defend its borders, so the army was forced to hire fighters from the occupied lands known as auxiliaries or auxilia. These former barbarians were trained in the ways of the legion and would be rewarded with Roman citizenship if they served for 25 years. The influx of soldiers from far-away lands did change the make-up of the army. An example would be the archers recruited from occupied lands in Asia Minor who used their bows to deadly effect. Auxiliaries also helped usher in a new era of chain mail and rounded shields rather than lorica segmentata and scutum. The auxiliaries' role was to support the main legion in their own specialised cohort. They were roughly paid a third of what a standard legionary received and were stationed away from their native lands to ensure they did not switch sides. This non-citizen corps aided the army greatly by making its tactics more diverse with new cavalry and archer units.

"THIS NON-CITIZEN CORPS AIDED THE ARMY GREATLY"

THE LEGIONARY

COMING FACE-TO-FACE WITH A ROMAN SOLDIER WOULD MAKE ANY BARBARIAN SHAKE IN HIS BOOTS, AND HERE'S WHY

PILUM
This long spear was thrown from a distance at the start of a battle to unsettle the enemy ranks.

ARMOUR
Made from strips of iron, a legionary's armour was tough enough to withstand barbarian blades.

GLADIUS
The Roman soldier would use this short sword for fighting at close quarters.

SANDALS
Known as 'caligae', these sandals were standard issue for the army.

HELMET
The Romans had a variety of helmet types including the coolus and montefortino. The one shown here is a cassis helmet.

TUNIC
To march long distances and still fight effectively, the Roman soldier's tunic was light, warm and comfortable.

SCUTUM
The iconic rectangular shield protected the whole body and enabled the testudo formation to be used.

ROUND OR RECTANGULAR SHIELDS?
The rectangular scutum was the iconic Roman shield, but legionaries throughout the Empire also carried circular shields, which copied Greek hoplite designs.

FORMATION & TACTICS

THE ROMAN BATTLE LINE WAS UNLIKE ANYTHING SEEN BEFORE AND WAS IDEAL FOR DEALING WITH NEARLY ANY SCENARIO

A professional and conscripted force, the Roman military introduced many new and innovative features of warfare. Prior to the Empire, the phalanx was the dominant tactic on ancient battlefields but the Romans successfully made this once great formation obsolete in a matter of decades.

BATTLE OF MONS GRAUPIUS

RISE OF THE TESTUDO

This battle was fought in the Highlands and could well be the testudo's finest hour. Faced with the fierce local Caledonian tribes, the strict structure of the Roman ranks tactically outclassed the men from the Highlands. As the Caledonians hurled their spears towards the Romans, the legionaries went into their tortoise shape, nullifying the impact of almost every single spear. The chariot and infantry charge followed next but these were dispatched with ease by the close-knit Roman ranks. With the tortoise in full flow, these unarmoured and unprofessional militia stood no chance.

TESTUDO

The testudo (tortoise) could be useful in both open battlefields and in sieges. Using their near-body-length scutum shields, a division of legionaries could be almost impenetrable to projectiles, as they edged closer to enemy forces or defences. The idea was developed from the Greek and Macedonian phalanx formation.

Strengths: Allowed advances into enemy territory while protected from projectiles.

Weaknesses: Could not launch a quick attack very easily.

ORB

When a group was split from the main force and had been encircled by enemy troops, an orb formation would be deployed. This would only be used in desperation and as a sort of 'last stand', but could hold off enemies in order to gain valuable time for a retreat or escape.

Strengths: Useful for legionaries who had been detached from the main body of the army.

Weaknesses: Left vulnerable, isolated and easily surrounded.

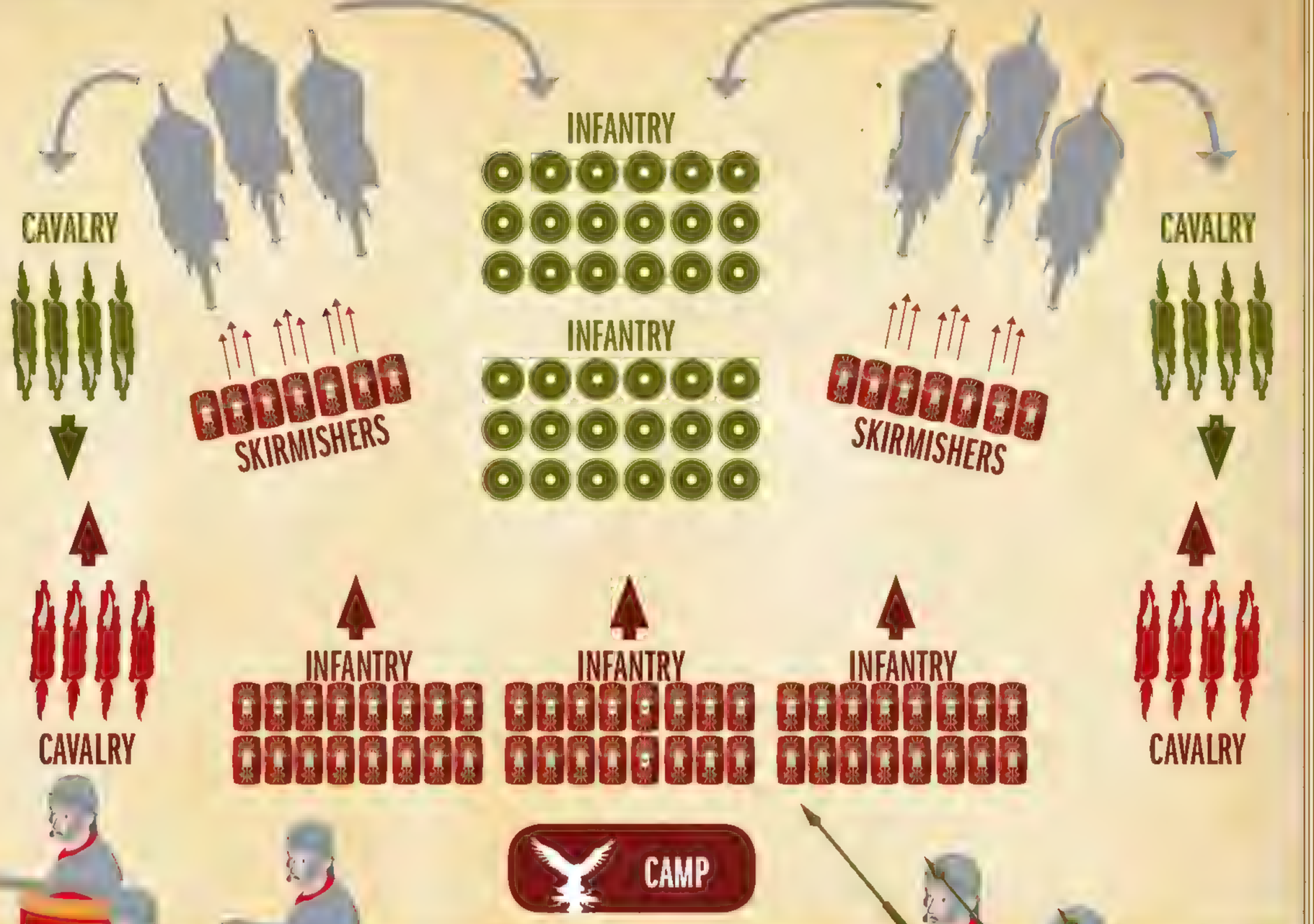
WEDGE

A more aggressive formation than the testudo and the orb, the wedge made an effective use of the Roman sword of choice, the gladius. The soldiers would form a triangle shape with the tip facing the enemy and charge straight into the enemy. The idea was to disrupt enemy lines and make use of the gladius' advantage over barbarian broadswords in close-quarter combat.
Strengths: Took the enemy by surprise.
Weaknesses: Risky strategy if not undertaken properly.

BATTLE OF ILIPA

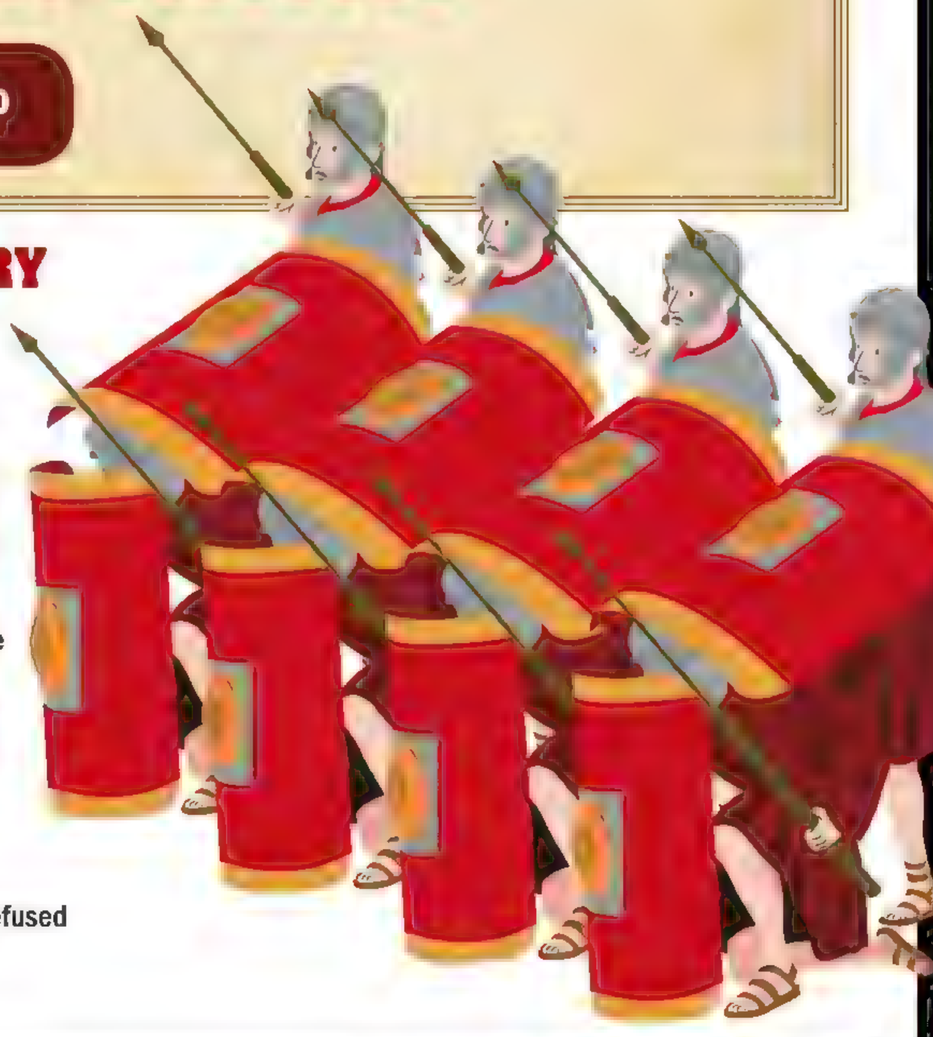
COUNTERING WAR ELEPHANTS

The skirmish tactic was utilised superbly by General Scipio in a battle that effectively ended the Carthaginian grip on Spain. Facing a full elephant division and 10,000 more men, Scipio used his skirmisher (velite) troops to hurl javelins at the enemy camp before dawn. The Carthaginians scrambled to their posts and were met with the Roman army on their doorstep. In disarray they sent out their elephant divisions but the wide gaps in the Roman ranks meant the elephants did as much damage to their own forces as they did to the enemy before they were brought down by skirmisher javelins.



SKIRMISH

The Roman army wasn't always organised into tightly packed clusters. What gave it the advantage over the phalanx was its ability to spread out and double the size of its ranks. This would enable the commander to make use of velite skirmisher units who hurled javelins at the enemy before the infantry rush.
Strengths: Very effective against phalanx tactics.
Weaknesses: Ranks vulnerable to a counter attack.



ANTI-CAVALRY

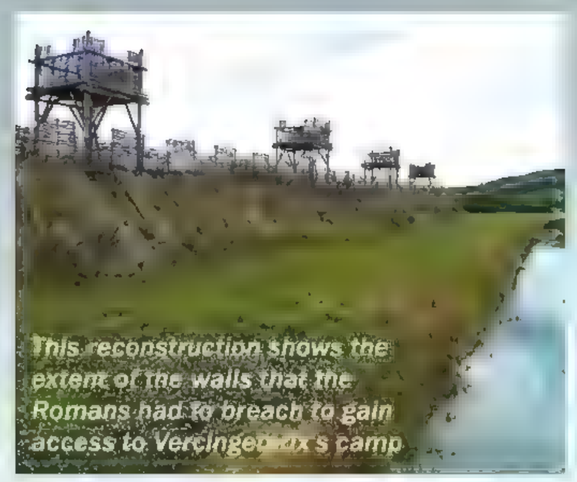
On the ancient battlefield, the horse was the tank of the age. The Roman Legion devised a way to repel a cavalry charge by forming a tight barrier of shields with their pilum spears pointing out from the front. When faced with this wall, a horse would often pull up and then be at the mercy of the Roman archers.
Strengths: Effective tactic against a greatly feared battlefield weapon.
Weaknesses: If the horse refused to pull up...

WAR ENGINES & SIEGES

IF A SETTLEMENT STOOD IN THE WAY OF THE ROMAN JUGGERNAUT, THE TRUE POWER OF THE EMPIRE'S SIEGE MACHINES WOULD BE UNLEASHED

As the Roman war machine swarmed across Europe, it would occasionally come into contact with heavily fortified enemy forts and towns. By destroying these centres, the Romans could deal a sizeable blow to the enemy forces and plunder the city of its resources and riches.

The siege would begin with the construction of a series of forts and guard towers around the city. This would prevent any enemy reinforcements reaching the city and cut off the water and food supply to the defenders. If the settlement still resisted, the full force of a siege would begin.



This reconstruction shows the extent of the walls that the Romans had to breach to gain access to Vercingetorix's camp

THE BESIEGED CITY

Once victory was complete (this could take weeks, months, or even years), the Romans would pillage the city for everything of worth. The only survivors would be women and children for use as slaves in the Empire. In the siege of Syracuse, the Roman legionaries were under strict instructions to capture the Greek genius Archimedes, whose siege weapons had wreaked havoc with the Roman advance, alive. Unfortunately the message was not heeded and one of the greatest thinkers in the ancient world was killed by a Roman gladius.

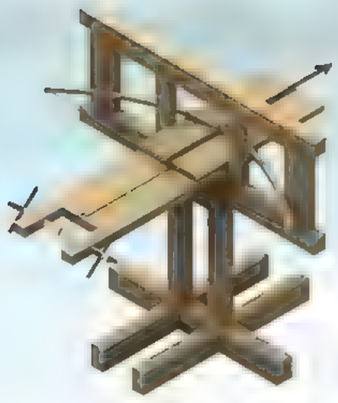
FAMOUS SIEGES

Perhaps the most important of all the Roman sieges was Carthage. The centre of the Carthaginian Empire, it was sacked in 146 BCE ending the third and final Punic War. Another famous event was the siege of Alesia, which signalled the ending of Gaul's resistance after Julius Caesar surrounded Vercingetorix's camp and successfully defeated the leader of the Arveni Gauls. There were also sieges at sea, with Syracuse being the most prominent example.

After a successful siege, the city would be razed to the ground in order to prevent any future uprisings and to send a message to other enemies. This image shows the once great city of Carthage

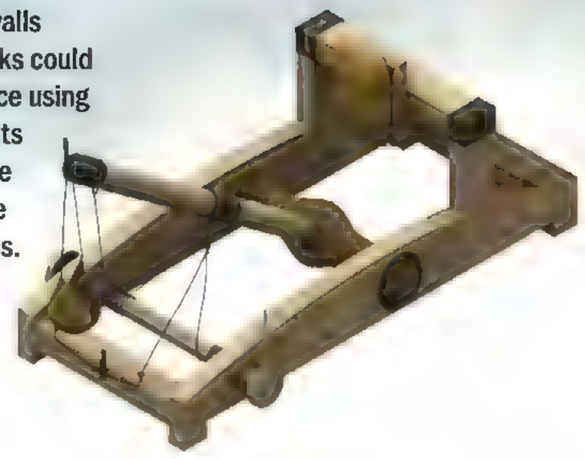
MINING

If faced by some particularly tough resistance, the legionaries would sometimes dig under the ramparts. Using the other siege engines as a distraction, hordes of soldiers could infiltrate inside the city, defeating the defenders from within.



ONAGER

If getting close to the walls wasn't an option, attacks could be made from a distance using onagers. These catapults hurled rocks against the battlements from range using torsion mechanics. They were used to target archers on the battlements, or even the walls.



BALLISTA

Rather than solely targeting the walls, ballistae were used against the rival infantry in a siege. Shooting giant metal bolts over 300 metres (984 feet); the ballista could strike fear into the heart of the enemy. This siege engine was the bigger, more destructive brother of the smaller scorpion.

SIEGE TOWERS

Towers were essential to most Roman sieges. Wheeled up to the enemy battlements, they shielded troops from attack and enabled high defences to be scaled and breached. They could also house other siege engines to ensure they got as close as possible to enemy fortifications.

BATTERING RAMS

Containing an iron hammer shaped like a ram, Roman battering rams could quickly reduce forts to rubble. The soldiers inside the ram were protected by wooden roofing as they targeted the weakest sections of the battlements. However, battering rams could occasionally be ineffectual when faced with strongly fortified walls.

Sol 90 Images; Mary Evans; Osprey Publishing

CASTLES

Built to protect and defend, how have castles changed over the centuries?

THE MIZUKI 'WATER FORTRESS' – JAPAN'S FIRST CASTLE

AN EARLY DESIGN, BIG IN JAPAN IN THE 7TH CENTURY

664 Japan

Before the first castles were built in Japan, temporary forts and fortified homes were common. But, as the threat of invasion from China and Korea grew during the 7th century, the need for more formidable defences became clear, and Japan's first free-standing castle was built at Dazaifu.

Korean and Chinese forces were successfully beaten back at the Siege of Ulsan

The Tower of London was among the first stone castles built in England

FIRST STONE CASTLES BUILT IN BRITAIN

A NEW ERA OF CONSTRUCTION

1067 England

After being made Earl of Hereford, William fitzOsbern began work on Chepstow Castle along the Welsh bank of the River Wye. Soon after, construction of the iconic Tower of London was completed. These early stone castles replaced earlier motte-and-bailey predecessors, often building over their foundations. Over the next century, dozens of stone keeps were built throughout Britain.

ARTILLERY FORTRESS – PENDENNIS CASTLE

NO LONGER JUST FOR PROTECTION

1539 England

Commissioned by Henry VIII, Pendennis was part of a new breed of castle designed to both withstand bombardment by cannon and return fire. Part of a string of artillery castles built to defend the English coast, among the only action it saw was during the First Civil War, when it was besieged by a Parliamentarian army in 1646.

Guns at Pendennis Castle saw action in World War II

THE SIEGE OF CANDIA – THE LONGEST SIEGE IN HISTORY

PROVING THE STRENGTH OF THE FORTIFIED STRUCTURES

1648-1669 Crete

The longest siege in recorded history began in 1648, when the Knights Hospitaller captured an Ottoman convoy. In retaliation, the Ottomans dispatched 60,000 troops to besiege the Hospitaller base at Candia on Crete. For 21 years they occupied the island, besieging the castle and town. The stalemate only ended when the garrison dwindled and was starved into submission in 1669.

The city of Candia was under siege from Ottoman forces for 21 years

"KRAK DES CHEVALIERS, NEAR THE EMBATTLED SYRIAN CITY OF HOMS, BECAME A REBEL STRONGHOLD THAT HAS SINCE BEEN FOUGHT OVER NUMEROUS TIMES"

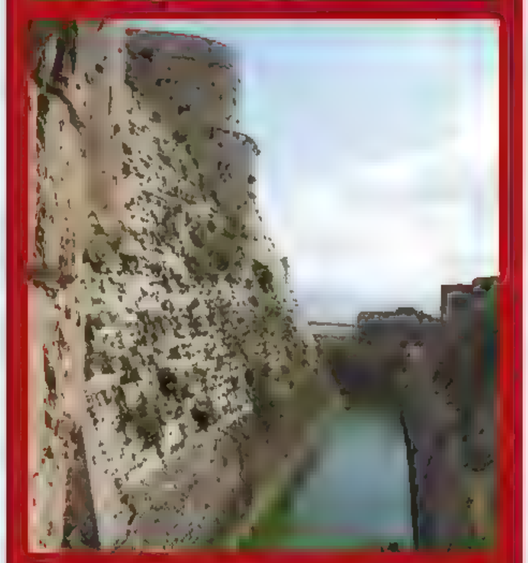
A scene from the Bayeux Tapestry depicting the siege of the Château de Dinan

KRAK DES CHEVALIERS

STILL STANDING AFTER MORE THAN 800 YEARS

2011-present Syria

Even in the 21st century, castles continue to play a part in conflict. In 2011, the 800-year-old Crusader castle Krak des Chevaliers, near the embattled Syrian city of Homs, became a rebel stronghold that has since been fought over numerous times. The castle has been heavily damaged by shelling.



Top: Syrian Crusader castle Krak des Chevaliers, as seen from the southwest
Middle: As well as being positioned on top of a hill, the castle has a moat
Bottom: The castle is made up of many structures, including this aqueduct

MOTTE-AND-BAILEY CASTLES

QUICKLY BUILT BEACONS OF POWER

950s Northern France and England

Motte-and-bailey castles were quick, easy and cheap to build. Made up of the motte, a mound of earth, and the bailey, a ditch and wooden palisade enclosure, the design originated from northern Europe and was used by the Normans as they expanded their territory. Ideal for quickly securing newly conquered territory, William the Conqueror built hundreds across Britain.

Arundel castle's motte and quadrangle

FORT MCHENRY – THE STAR FORT ENDURES

THE STAR-SPANGLED SYMBOL OF RESISTANCE

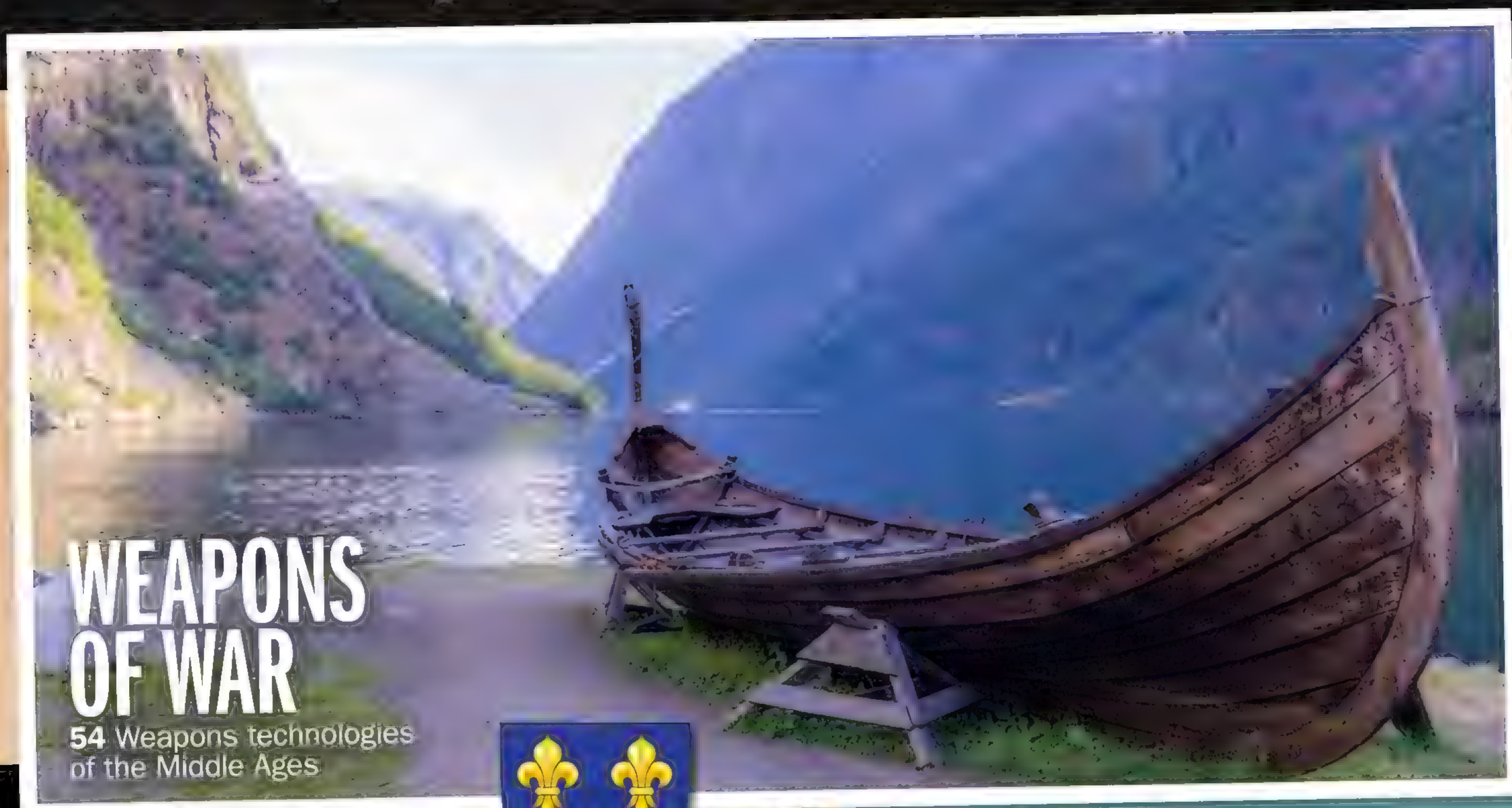
September 1814 USA

Built in the 18th century to defend Baltimore harbour from naval attacks, this modern incarnation of the traditional castle followed the five-pointed star design to maximise the efficiency of the fort's guns. During the War of 1812, a British bombardment of McHenry inspired Francis Scott Key to write his poem *Defence of Fort M'Henry*, later adapted to the USA's national anthem.

THE MEDIEVAL ERA

WARFARE IN THE MEDIEVAL WORLD

50 Travel, trade and conquest spread new and inventive ways of warfare across the globe



WEAPONS OF WAR

54 Weapons technologies of the Middle Ages

THE BATTLE OF AGINCOURT

62 Discover the definitive battle of the British longbow

THE BATTLE OF KALKA RIVER

72 How composite bows made Gengis Khan's Golden Horde undefeatable

"UNLIKE THE WELSH/ENGLISH LONGBOW, THE MONGOLIAN REFLEX BOW WAS OF COMPOSITE CONSTRUCTION, MADE OF GLUED BAMBOO, SINEW AND YAK HORN"

WARFARE IN THE MEDIEVAL WORLD

Travel, trade and conquest between nations spread new and inventive ways of warfare across the globe with explosive results

WORDS BEN GAZUR

By the 5th century CE, the Western Roman Empire was losing its control of its former domains. Visigoths and Vandals sacked the sacred city of Rome itself, and with the deposing of Romulus Augustus, considered by some as the last true Roman emperor, the age of antiquity was over and the medieval period began. Warfare became a way of life for the new bickering states of Europe, yet they could not afford to consider only their near neighbours. A new global age was rising, and improvements in weapons and the arts of war could spread across continents. The world of war was changing forever.

A clash of swords

Medieval warfare gleamed with the brilliance of polished steel. Swords, daggers and axes were forged from vicious steel capable of tearing, stabbing and slashing through flesh. The sword is the weapon most associated with medieval warfare, and underwent various improvements over the centuries. The basic swords of the early medieval in Europe were used for hacking at opponents but lacked many features, such as enlarged crossguards to protect the hand, that later knightly swords would have. Fighting styles determined the ways swords developed in various places. Cultures where most fighting was done on horseback, such as the Mongol, used a curving blade less likely to catch on a target and be ripped from the hand.

In many battles of the medieval period it was the horseman who dominated, but infantry still had its place in the line of battle. A one-handed axe could be easily wielded by a warrior on a horse to devastating effect, but many foot-soldiers used a larger two-handed axe in battle. Towards the end of the period, formations such as the Swiss pikemen appeared, using massed infantry armed with long spears, pikes and halberds (which developed from axes), offering a defence against the charge of cavalry. When the enemy knights were off their horses, it was not uncommon for archers and other foot soldiers to dart in and dispatch them with a dagger.

Even in an age of bristling blades there was still room for simpler weapons. The Bayeux Tapestry shows Bishop Odo riding into battle brandishing a wooden club. Heavy maces and war hammers could be used to batter an enemy into submission by crushing their armour, as well as the soft body beneath.

From arrows to cannons

Archers played a vital role in the medieval army, often making up well over half of the numbers of soldiers present. While the complex composite bow had been invented much earlier, the simple longbow was favoured by European forces. The longbow required a great deal of training, but a skilled archer could shoot at a rate of 12 arrows per minute, striking targets at a distance of 300 metres. At the Battle of Crécy, English longbowmen held off a force of Genoese crossbowmen whose launch rate was a mere 3-5 volleys per minute.

DERVNT
LE VVIN
ET GYRD FRATRE

Chinese forces of the time did use crossbows effectively. While crossbows lacked the range and speed of the longbow, a bolt shot from a crossbow was more capable of penetrating armour. Chinese improvements to the basic crossbow design made them formidable weapons. Repeating crossbows allowed an archer to swiftly reload their weapon with just the pull of a lever. Some crossbows had sights added to increase their accuracy, or shot multiple bolts at once.

With the growth of castles as strategic sites, technology was needed to break their defences. The trebuchet appeared in European and Middle Eastern armies around 1200 CE. Using a long slinging arm and counterweight, the trebuchet could hurl a 90-kilogram projectile over 300m. Few defences could stand up to direct and sustained bombardment. The trebuchet could bypass thick walls entirely and bring a city to ruin by flinging burning projectiles onto flammable roofs. It was the Chinese invention of gunpowder that was to blow away the bow and the trebuchet as forces on the battlefield forever. The refinement of gunpowder exploded into world history and ushered in the modern age of warfare.

"A NEW GLOBAL AGE WAS RISING AND IMPROVEMENTS IN WEAPONS COULD SPREAD ACROSS CONTINENTS"

Knights in shining armour

Horses had always had their place in warfare, but it was in the Middle Ages that they took centre stage. The invention of the saddle and stirrups allowed a warrior to ride and fight from horseback securely. These developments led to soldiers who fought entirely from horseback, not simply using a horse to traverse the battlefield. It is from these that knights evolved. The knight took many years to train and required a great deal of money to kit out. It was worth it, as the knight and his horse were able to cover large distances much faster than a force on foot, and in battle a cavalry charge could break an enemy's lines or outflank them. The knight might carry a sword, mace or axe, but the use of a long lance was especially useful in driving an enemy before you. By couching the lance underarm, the full force of the charging horse was placed in the tip.

Outside of set-piece battles, mounted soldiers made excellent skirmishers and scouts. The most mobile army of the medieval period was undoubtedly the Mongol Empire, who owed their remarkable expansion to their horses. In less than 40 years the Mongol Empire conquered lands from the Pacific coast of China to the walls of Vienna. Much of their success came from training in horse riding, which started in infancy, and the number of horses the Mongol Empire had. A single soldier might take several horses on campaign, changing to another horse as one tired, and so cover ground more quickly. High-sided saddles and stirrups that could support a soldier's full weight made Mongol mounted fighters particularly adept at rapid changes in formation. A Mongol warrior might ride in slashing with a sword, but was

GUNPOWDER

Gunpowder was first discovered by Chinese sages searching for the elixir of life. Called 'Fire Medicine' in Chinese, gunpowder's unrivalled ability to maim and kill would make it one of the bitterest pills mankind has ever had to swallow.

The first military use of gunpowder came in the form of fire arrows in the 10th century CE. Arrows with gunpowder packages were used to spread fire in cities. Later refinements attached tubes of gunpowder to propel the flight of arrows. There is little evidence of these early innovations making much impact on the battlefield, however.

The fire lance changed warfare forever. Originally a spear with a cylinder of gunpowder at the end, they were used to scare the enemy and spray them with fire. Later it was found that by placing broken pottery and other shrapnel in the gunpowder mix they could injure the foe. Mongol warriors were particularly terrified of fire lances, perhaps due to their effect on horses. Over time the spear was abandoned, but the idea of using gunpowder to launch projectiles had taken root.

The hand cannon developed in China in the 13th century, consisting of a small metal tube that fired stones, metal spheres or arrows by the igniting of gunpowder. Increasing the size of the tube and the projectile it fired produced even more powerful cannon. It is not entirely clear how knowledge of gunpowder reached Europe, but manuscripts from the 1320s mention cannon. Giovanni Villani mentions cannon at the Battle of Crécy in 1346: "The English guns cast iron balls by means of fire... They made a noise like thunder and caused much loss in men and horses."

Defining moment
GREEK FIRE
672 CE

In a battle against an Arab fleet the Byzantine ships used Greek fire, a flammable liquid that burned on water, to set the enemy ablaze. Projected through the use of pressure and heat, jets of Greek fire could be aimed any target. Particularly favoured in naval battles it also found use in sieges and on the battlefield. The recipe for Greek fire was a closely guarded military secret and is now lost to us. Greek fire showed how useful chemistry could be in war and paved the way for the arrival of gunpowder.

Defining moment
GUNPOWDER
11TH CENTURY

The first explosive was invented in China and soon found its way into the arsenals of many nations. At first in Europe its use was limited by the difficulty of finding the raw materials to make it. Initially the appearance of gunpowder was most effective in terrifying one's enemy. In time however, gunpowder changed the entire shape of war. On the battlefield it could be used to launch arrows, bullets, and cannonballs. In sieges it offered an opportunity to destroy the walls protecting cities and castles by constant bombardment with heavy projectiles.

TIMELINE OF MEDIEVAL WAR

BATTLE OF TOURS
Charles Martel's army halted the forces of the Umayyad Caliphate. His disciplined infantry was able to withstand repeated cavalry charges – one of the last triumphs of infantry in this way for centuries.
732 CE

VIKING LONGSHIPS
Long, sleek, and shallow-bottomed Norse longships were able to cross oceans, but also carry raiders up rivers. Longships struck at major European cities and coastal regions, and also acted as troop carriers for larger invasions.
9TH CENTURY

MINING
The rise of stone castles meant attackers needed new ways to bring down their walls. By mining underneath walls and towers, then collapsing the tunnels, besiegers could reduce a castle to ruin.
12TH CENTURY

FREE COMPANIES
The nations could not afford to support standing armies, so between wars soldiers had to find other employment. Free companies were formed from bands of soldiers willing to work for any state able to pay them.
12TH-14TH CENTURY

Medieval battles could turn into a melee of many different weapons. The Battle of Auray began as a siege but ended in a bloody and confused battle

equally able to turn in their saddle to shoot an arrow as they retreated.

Shields and sieges

Personal armour came in many forms. Single plates of metal had been shaped into pieces of armour like cuirasses for centuries. These offered superb protection, but were heavy. Other types of armour relied on tough fabrics or woven materials to offer protection. Chainmail armour had been available, though expensive, since the ancient world. In the medieval period, armour developed to offer the best of all worlds. Plate armour made of steel emerged in the 13th century. Made of many jointed parts, it was surprisingly light. The image of the medieval knight as a man trapped in an immobile suit of armour is incorrect. To fight effectively a knight required full range of motion. The chinks where plates of metal met would allow weapons to penetrate, so chainmail was often worn underneath. Because of the value of a well-trained warhorse even they were often armoured, making a knight the medieval equivalent of a tank.

A unique feature of medieval warfare in Europe was the castle. Increasing raids in the 10th century may have provoked lords to fortify their homes. The first castles relied on ditches, mounds, and palisades for protection, but these were soon replaced by stone structures surrounded by thick walls. A well-placed moat could keep your enemy from even approaching your walls. A castle could be a kingdom all to itself in an emergency.

With the raising of castles, many campaigns to capture territory turned into protracted sieges. Advances in castle design made them ever harder to capture. Concentric rings of defences meant that even if one area was breached, defenders could strike back from another position. When trebuchets began battering walls with flung stones, rounded towers that were better able to deflect them were developed. Even the arrival of gunpowder did not bring castles tumbling down.

HORSE FLESH

Like all domesticated animals, the horse has been selectively bred into forms that best serve human needs. If a horse could not carry the weight of a fully armoured knight in battle then it was of little use. Via careful animal husbandry, a number of types of horse were developed. Rather than being true breeds as we would know them today, horses were classified by the tasks they were best suited to. The destrier was the most famous of horses in the medieval period. Known as the 'great horse' because of its size, they were used in both battle and jousting. A destrier could be a weapon of war in itself – the aggressive kicks and bites of a stallion could make all the difference in a close fight.

The most common horse used in battle was the courser. Smaller than the destrier they were lighter, faster, and less expensive. Poorer knights and men-at-arms might train a rouncey for battle, though these horses were also used when speed was most prized.

The warhorse was a vital part of the knight's equipment. Breeding and training horses for battle took many years

The hobelar was a soldier who rode a hobby horse. Quick and agile, the hobby was often used by skirmishing forces and guerilla-fighters harrying an enemy. Hobelars would travel light and their horses were unarmoured to lessen their load.

"THE IMAGE OF THE MEDIEVAL KNIGHT AS A MAN TRAPPED IN AN IMMOBILE SUIT OF ARMOUR IS INCORRECT. TO FIGHT, A KNIGHT REQUIRED A FULL RANGE OF MOTION"

Defining moment

FALL OF CONSTANTINOPLE
1453 CE

The Byzantine Empire capital of Constantinople was one of the most heavily fortified cities in the world. In 1453 the Ottoman sultan Mehmed II arrived with around 80,000 soldiers and besieged the city. Alongside his men he brought 70 pieces of artillery. One of the huge cannons was able to launch a stone ball weighing 250kg over a mile. The smaller cannons of the defenders had nowhere near the range. For weeks the Ottoman cannons fired on the walls of Constantinople. In the final attack the weakened walls collapsed, taking the Byzantine Empire down with them.

- **MONGOL CONQUESTS**
  Genghis Khan led the Mongols from central Asia to conquest in China and the edge of Europe. Successive khans expanded this empire through the use of rapid travel of armies on horseback.
  13TH CENTURY CE
- **NEST OF BEES**
  The Chinese 'nest of bees' was an early use of gunpowder in projectile warfare. A tube containing dozens of arrows, each with a small rocket attached, nests of bees could deploy thousands of arrows simultaneously.
  14TH CENTURY
- **BIOLOGICAL WEAPONS**
  A Mongol army besieging Caffa on the Black Sea used catapults to launch the corpses of plague victims over the city walls. The disease soon spread, carried back to Genoa and Venice by merchants.
  1346
- **BATTLE OF AGINCOURT**
  The French cavalry expected to simply ride over the numerically inferior English. Instead archers, making up over 80 per cent of the English force, slaughtered the knights. The importance of ranged weapons was established.
  1415

- **PLATE ARMOUR**
  The full suit of armour favoured by knights and men-at-arms offered protection for the whole body yet wearers could run, jump, and fight with ease. Survived until guns developed with enough power to pierce steel.
  15TH CENTURY

An illustration of a 14th–17th-century timariot, a Turkish knight with a scimitar hanging at his belt

"THE LIGHT, CURVED BLADE WAS IDEAL FOR SLASHING WITHOUT SACRIFICING ANY OF THE RIDER'S MOMENTUM, UNLIKE A STRAIGHT SWORD USED BY THE CRUSADER KNIGHTS, WHICH RELIED ON BRUTE FORCE FAR MORE THAN IT DID A CUTTING EDGE"

A 16th-century Turkish depiction of the army of the Prophet at the Battle of Uhud (625 CE). Note that the cavalry are all armed with scimitars

TURKISH SCIMITAR

7TH CENTURY

European encounters with the scimitar came with the Turkish migration to Anatolia in the 11th century and the Crusades of the 12th century onwards, but their use by Turkic nomads in Central Asia can be dated back to at least the 7th century.

Designed to be used by a warrior on horseback, the light, curved blade was ideal for slashing without sacrificing any of the rider's momentum, unlike a straight sword used by Crusader knights, which would often have to be lost or pulled free during a cavalry charge as it relied on brute force far more than it did a cutting edge.

Blades of Damascus steel – recognisable by an eye-catching finish that resembled oil in water – became especially coveted as they offered greater flexibility with no loss of strength or sharpness.

A 14th-century German standing shield pockmarked with holes from crossbow bolts

FRENCH ARBALEST

12TH CENTURY

Crossbows first appeared across the 5th to 2nd century BCE, but it wasn't until the 12th century that they began to displace hand bows (with the exception of the English longbow, which was still in use in the late 14th century). This was thanks to the use of steel arms with greater tensile strength and more sophisticated winding mechanisms that increased the torsion to the point where they could rival the longbow for stored energy. These new, heavier crossbows, with their considerable reloading time, affected the way that crossbowmen fought in comparison to more mobile archers. In the field they often carried a large shield (a pavise) on their backs, which could be driven into the earth to provide cover.

"THESE NEW, HEAVIER CROSSBOWS, WITH THEIR CONSIDERABLE RELOADING TIME, AFFECTED THE WAY THAT CROSSBOWMAN FOUGHT IN COMPARISON TO MORE MOBILE ARCHERS. IN THE FIELD THEY OFTEN CARRIED A LARGE SHIELD TOO"

An 18th-century illustration of a crossbowman with his shield, or pavise, mounted on his back

VIKING LONGSHIP

9TH CENTURY

Narrow, light and shallow hulled, the longship allowed Norse raiders to strike quickly and without warning. Their low weight meant the crew could pick up and carry them, while the shallow hull enabled the longship to traverse rivers to take the fight inland.

While not exclusively a weapon of war – many were built for trade or exploration – the Northmen themselves were well aware of the fearsome reputation of their vessels, carving monstrous designs into the bows that led the Anglo-Saxons to nickname them 'dragonships'.

Though rarely used for ship-to-ship combat – few enemy vessels could match their speed – in the 10th century multiple ships were recorded as being lashed together to create fighting platforms.

Engraving of Viking longboats navigating a river

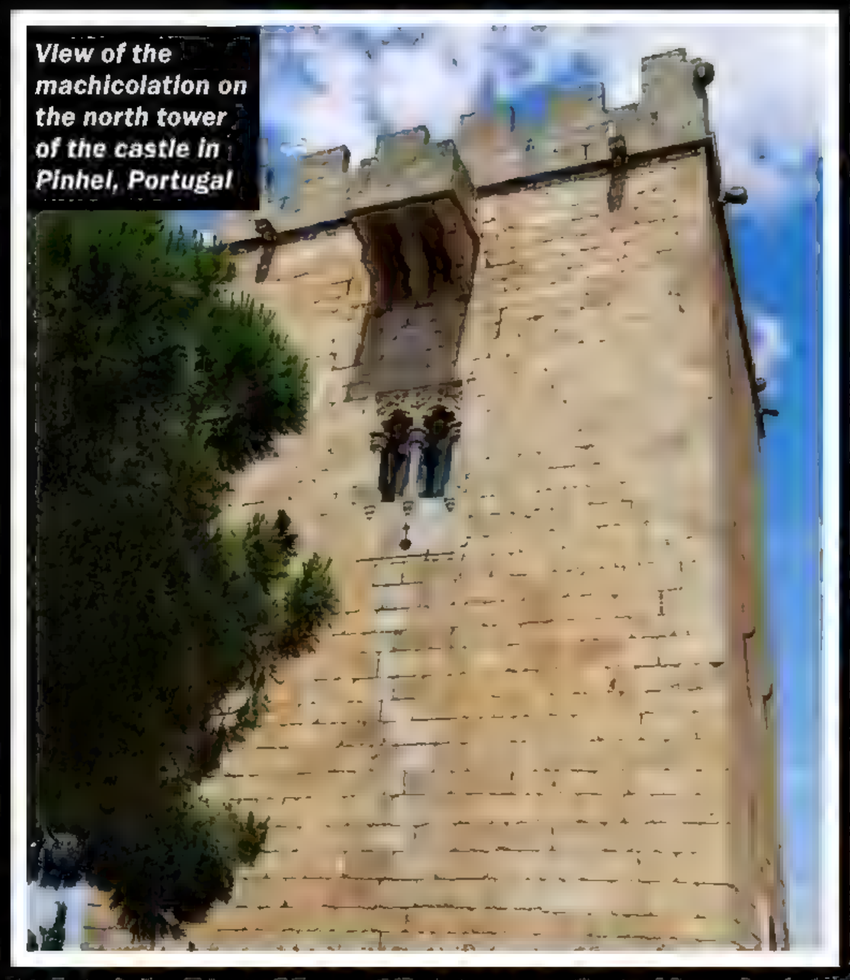
MACHICOLATION

13TH CENTURY

Machicolations – also known as drop boxes – were inspired by similar defensive boxes on Islamic fortifications in Syria and were quickly adapted by the Crusaders for stone castles in the short-lived Crusader States, soon spreading to France, Spain, Rhodes, Malta and England.

These overhanging stone enclosures (the original Arab ones were wooden) began to appear in mainly French castle designs in the 13th century, allowing defenders during a siege to drop stones or pour boiling oil or water directly down onto the attackers while remaining sheltered from projectiles.

Machicolations can be seen on the tower to the right in this painting, which shows the Crusaders retaking Jerusalem in 1229.



View of the machicolation on the north tower of the castle in Pinhel, Portugal

Great Battles

AGINCOURT

WORDS JACK GRIFFITHS

After a long truce, Henry V's men took up their longbows and set sail for France. The Hundred Years' War was about to reignite

PAS-DE-CALAIS, FRANCE, 25 OCTOBER 1415

By the summer of 1415, France had regained the majority of its land from Edward III's conquests. Aquitaine and Calais were still held by the English, but the cross-channel invaders had been almost completely driven out of Normandy and Flanders. Back in England, Henry V had been sat on the throne for two years. In that time the warrior king had become intent on reclaiming vast swathes of France for himself.

Taking his claim from his great-grandfather Edward, Henry initially offered the French 1.6 million Crowns to recognise English rule, and ordered payment for the body of French King John II, who was captured at the Battle of Poitiers in 1356. Negotiations of these harsh terms predictably fell through, so Henry turned to military action.

As well as his burning desire for conquest, Henry had the ideal conditions for a successful invasion. Despite a recent plot to overthrow his rule, he had noble support, broadly there was domestic peace and, perhaps most importantly, unrest on the continent.

King of France Charles VI was prone to bouts of insanity, and in 1407, his troubled reign had led to the formation of rival factions in the Valois royal family. Louis, the duke of Orléans and brother of the king, had been murdered in Paris by the Burgundians, and civil war wasn't far away. France, after vanquishing the English in 1389, had descended into chaos. Henry was ready to strike.

"AS WELL AS HIS BURNING DESIRE FOR CONQUEST, THE WARRIOR KING HAD THE IDEAL CONDITIONS FOR A SUCCESSFUL INVASION"

THE BATTLE OF AGINCOURT BY GRAHAM TURNER

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Even though the rules of chivalry stated that no battlefield should favour either side, the location of Agincourt clearly held an advantage for the English

The invasion begins

Setting off from Southampton, Henry was convinced that he could unite the thrones of England and France – he fervently believed that English ownership of the French crown was his birthright and God's will. He landed in Normandy on 14 August with 8,000 archers and 2,000 men-at-arms, who were contracted for 12 months' service. On arrival, Henry stepped onto shore first and fell to his knees, praying to God to give him strength against his enemies.

The English army's plan began with a siege of the nearby town of Harfleur, which had been an important centre of operations for raids on the English coast. The invasion started with a stumble. The siege took much longer than expected, and the French commune put up fierce resistance for more than a month. When Harfleur finally surrendered on 22 September, campaigning season was almost over. The plans to take Paris and Bordeaux were put on hold as the English sought to take refuge in Calais for the winter. Leaving their artillery, 1,200 men and most of their baggage train behind as a garrison, they marched 160 kilometres (100 miles) north towards Calais. Before setting off, Henry contacted the governor of Calais, Sir William Bardolph, asking him to safeguard his chosen crossing point of the River Somme, the same point that Edward III had traversed in 1346.

The French had been tracking the English since the fall of Harfleur, and Charles had summoned knights from every part of his kingdom to engage Henry's military. Letters were sent to every noble in the realm as the king amassed a huge army to fight off the invaders. All weapons and cannon were removed from town defence duties and put into the field of battle. Although he was instrumental in assembling the soldiers, the king would not take to the battlefield, and in his absence, Marshal Boucicault and Constable d'Albret would lead the French forces. The main French army was situated in nearby Rouen, but only watched as Henry marched uncontested towards Calais. His army was so large that no town or village dared oppose him, and he had no need to pillage as almost every town offered food to the king for his soldiers and horses.

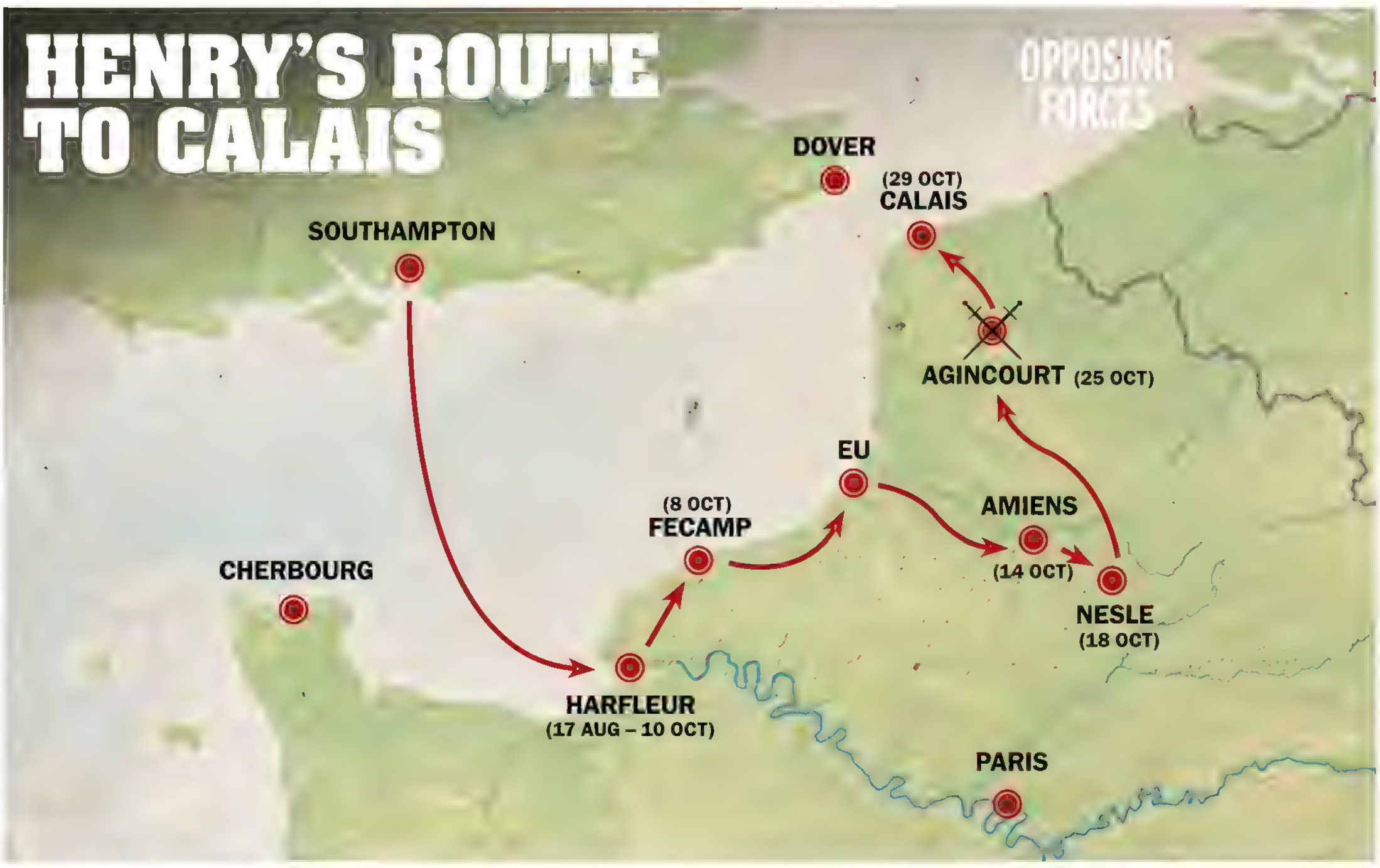
D'Albret and his men were intent on engaging the English near to their own strongholds at Abbeville and Amiens. The scene of Edward III's emphatic victory at Crécy was near here, so the French were keen to get revenge on the same piece of land 69 years after their defeat. However, this idea didn't go to plan, and instead the French cut off the English at the Somme.

When Henry made it to the river estuary, there was no sign of Bardolph, and to his surprise, the French had barricaded the main crossing. Henry had to divert to another bridge, stretching both his resources and the resolve of his men. After finally crossing the river, they were met by the French 48 kilometres (30 miles) from Calais. Two

OPPOSING FORCES

ENGLISH	FRENCH
Henry V	Charles I of Albret
Approximately 500 – 1,000 men-at-arms and 7,000 archers	Estimates range from 12-30,000 men-at-arms and knights, accompanied by crossbowmen and artillery
GAME CHANGERS	**GAME CHANGERS**
The power and shot rate of the English longbow had been upgraded since the days of Crécy and was wielded by skilled English and Welsh archers	Overwhelming numbers of men-at-arms and knights could smash the English lines while being protected from arrows by tough plate armour

"ON ARRIVAL, HENRY STEPPED ONTO SHORE FIRST AND FELL TO HIS KNEES, PRAYING TO GOD TO GIVE HIM STRENGTH AGAINST HIS ENEMIES"



days' march from safety and not far from the heavily fortified French town of Hesdin, appeals for a safe passage to Calais were refused. As the huge French army spilled over the horizon, there was now no way to avoid a pitched battle, and the chosen location was a forest between the villages of Tramecourt and Agincourt.

Amassing on the ridge

The exhausted and disease-ridden English army had marched for 17 days and was in no condition to fight. After having lived off nuts, raw vegetables and contaminated drinking water for days, the morale in the English camp on the eve of the battle was low. In contrast, the French camp was vibrant. New soldiers were arriving by the hour and they stayed up gambling and drinking, certain of victory the next day. So confident were some of the soldiers that they had even fashioned a cart especially for Henry's dead body to ride through the streets of Paris upon victory.

A cold and wet morning broke the next day. Winter was on its way and the freshly ploughed ground below the soldiers' feet resembled a mudpit after heavy overnight rain. The longbowmen took up their positions just before dawn on slight ridges overlooking both sides of the battlefield as well as interspersing themselves in the core of the infantry.

Although this was an English army, many of the longbowmen were Welsh. The longbow was first used in great numbers in Wales and some of the finest archers in the entire army came from there. The archers were joined by 500 men-at-arms who stood nervously in rank and file. Many of them were ordinary men, not seasoned veterans of battle, and they watched on as the French amassed opposite them with about six times as many men in their ranks.

King Henry, in crown and plumed bascinet, constantly encouraged his men and would fight shoulder to shoulder with them as he took charge of the centre, with Sir Thomas Erpingham manning the right and Lord Camoys leading the left. Thick forest enclosed both armies into a confined space of about 900 metres (2,950 feet) wide but the French were sure that there was still room for their cavalry to flank and ultimately encircle the English, striking the deadly archers from all directions. Their army was divided into three lines: the vanguard, the main body and the rearguard. One was mounted and two were on foot, with d'Albret and Boucicault leading the vanguard with the dukes of Bourbon and Orléans.

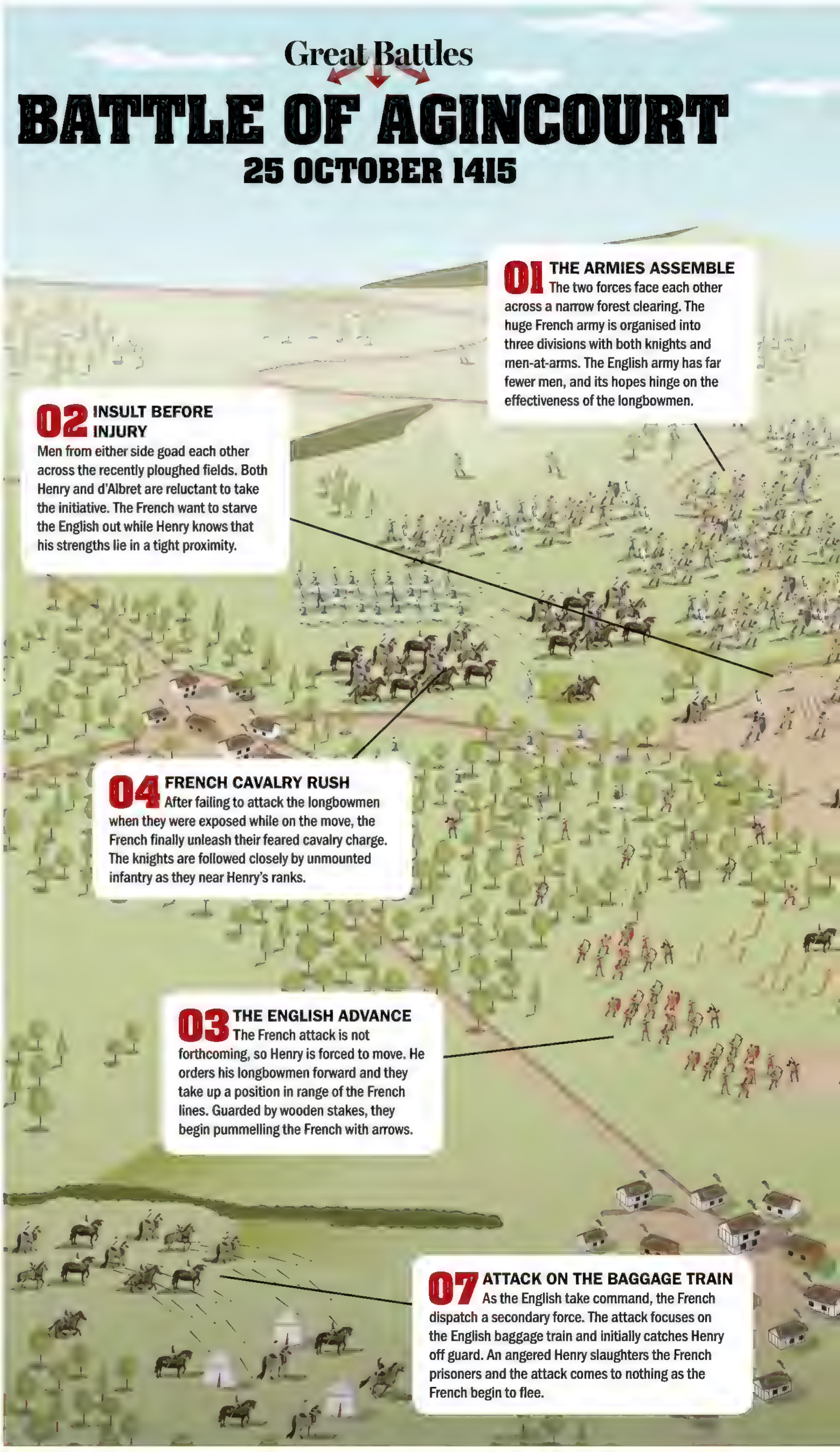
The French knew the threat the longbowmen posed and had upgraded their armour since the days of Crécy. They now wore thick steel plates with visor helmets. Each knight had a coat of arms proudly emblazoned on his shield, and

"THE LINES WERE SUCH A MESS THAT FALLEN TROOPS WERE CRUSHED DOWN INTO THE MUD, UNABLE TO RISE UP AGAIN DUE TO EXHAUSTION"

Great Battles

BATTLE OF AGINCOURT

25 OCTOBER 1415



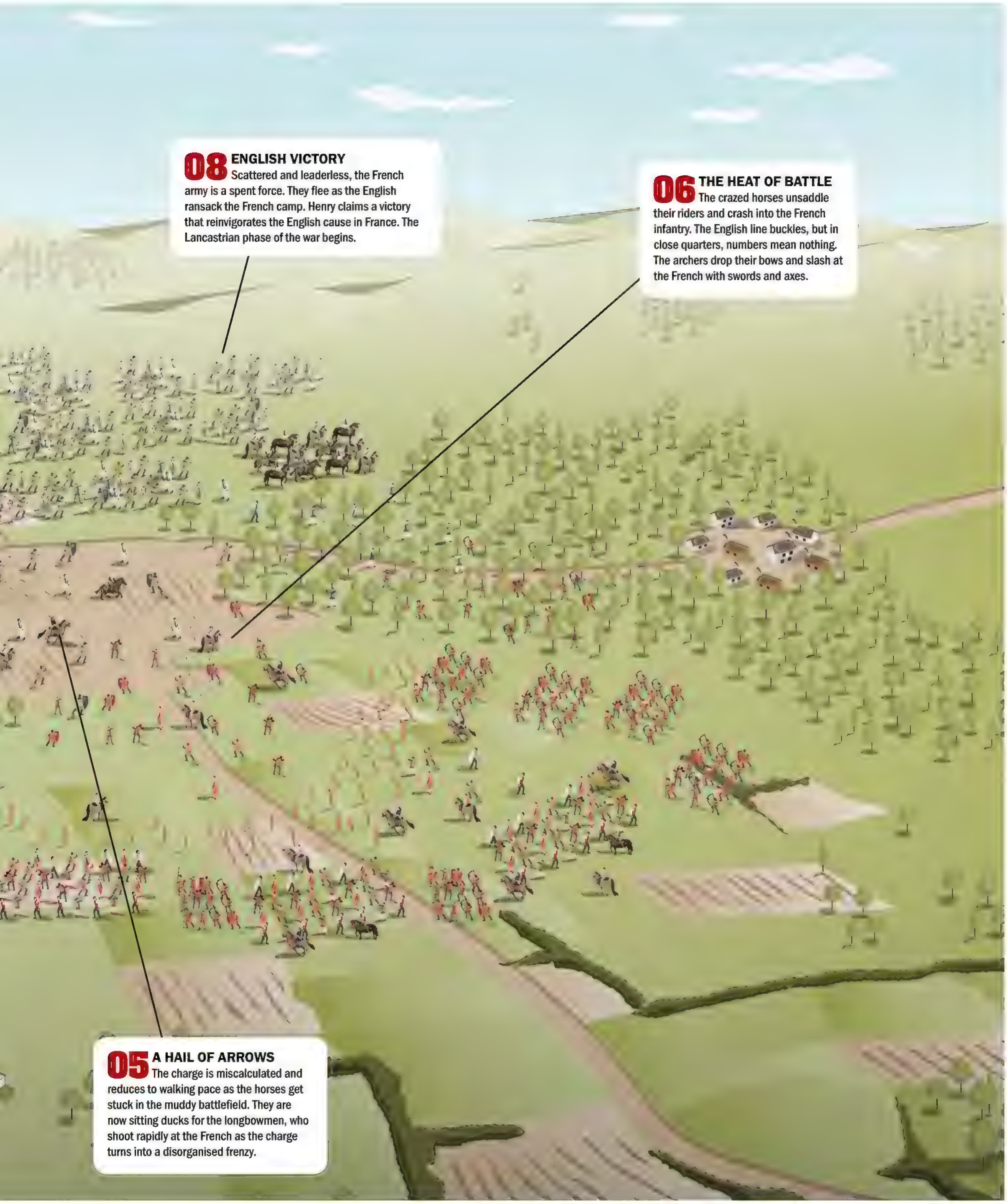
01 THE ARMIES ASSEMBLE
The two forces face each other across a narrow forest clearing. The huge French army is organised into three divisions with both knights and men-at-arms. The English army has far fewer men, and its hopes hinge on the effectiveness of the longbowmen.

02 INSULT BEFORE INJURY
Men from either side goad each other across the recently ploughed fields. Both Henry and d'Albret are reluctant to take the initiative. The French want to starve the English out while Henry knows that his strengths lie in a tight proximity.

03 THE ENGLISH ADVANCE
The French attack is not forthcoming, so Henry is forced to move. He orders his longbowmen forward and they take up a position in range of the French lines. Guarded by wooden stakes, they begin pummelling the French with arrows.

04 FRENCH CAVALRY RUSH
After failing to attack the longbowmen when they were exposed while on the move, the French finally unleash their feared cavalry charge. The knights are followed closely by unmounted infantry as they near Henry's ranks.

07 ATTACK ON THE BAGGAGE TRAIN
As the English take command, the French dispatch a secondary force. The attack focuses on the English baggage train and initially catches Henry off guard. An angered Henry slaughters the French prisoners and the attack comes to nothing as the French begin to flee.



Ed Crooks

08 ENGLISH VICTORY
Scattered and leaderless, the French army is a spent force. They flee as the English ransack the French camp. Henry claims a victory that reinvigorates the English cause in France. The Lancastrian phase of the war begins.

06 THE HEAT OF BATTLE
The crazed horses unsaddle their riders and crash into the French infantry. The English line buckles, but in close quarters, numbers mean nothing. The archers drop their bows and slash at the French with swords and axes.

05 A HAIL OF ARROWS
The charge is miscalculated and reduces to walking pace as the horses get stuck in the muddy battlefield. They are now sitting ducks for the longbowmen, who shoot rapidly at the French as the charge turns into a disorganised frenzy.

THE LONGBOWMAN

DRAWN FROM BOTH ENGLAND AND WALES, LONGBOWMEN WERE THE BACKBONE OF HENRY'S ARMY

ARROWS

Many different types of arrowhead could be used with a longbow. The simplest was the bodkin point, and the majority of arrows could penetrate even the very toughest plate armour.

THE LONGBOW

Made out of yew, ash, oak or birch, the longbow originated in Wales. By the time of Agincourt, it was one of the most feared weapons on the medieval battlefield.

ARMOUR

Unlike the men-at-arms, the longbowmen had very little armour except for a boiled leather jacket and occasionally a helmet. The tactics of an archer were based around being nimble and light-footed.

SECONDARY WEAPONS

When engaged in close-quarters combat, the longbowmen would drop their bows and fight with swords, axes and clubs. This was a last resort as archers worked best at a distance.

***Right:** Due to their limited armour, longbowmen were often positioned behind barricades or interspersed among troops with superior protection*

TRAINING

The longbow would be nothing if it wasn't in the hands of a trained archer. All sports except archery were banned on Sundays and the most talented were drawn into the English army.

TACTICS

Longbowmen were vulnerable to cavalry so would attack from range and flank the enemy. Each archer carried 60-70 arrows each, enabling up to about six minutes of continuous attack.

THE AGINCOURT CAROL

Deo gracias anglia
redde pro victoria.

the French battle standard, the Oriflamme, flew on flags above them. In response, the English soldiers carried a bow that was much more powerful than the one employed during the conquests of Edward III. Two-handed swords were wielded by the higher classes of infantry on both sides, but the majority carried one-handed swords or lances and even blunt weapons like maces, hammers and clubs.

Henry makes his move

Both sides spat insults at each other, as commanders became reluctant to make the first move. The French were unwilling to advance, as Boucicault in particular knew the English would starve if they went much longer without food. Henry was all too aware of this and finally rolled the dice as he ordered his longbowmen forward.

Kneeling and kissing the ground, the archers advanced until they were about 238 metres (750 feet) from the enemy lines. A trained archer could penetrate armour and kill or wound a target from up to 220 metres (721 feet) away. The French had already made their first error by not attacking the archers when they broke ranks and moved forward. D'Albert and Boucicault were experienced soldiers but lacked the authority and respect that a king like Henry would receive from his men.

"THE LONGBOWMEN IN THE CENTRE HAMMERED STAKES INTO THE GROUND, FORTIFYING THEIR POSITION IN A TACTIC LEARNED FROM PREVIOUS CONFLICTS IN THE WAR"

Unfortunately for the French, their king, Charles VI, was still in Paris, unable to lead his army due to his failing mental health. Back at Agincourt, several units of archers had secretly tracked through the forest surrounding the battlefield and into the nearby village of Tramecourt, creating another angle of attack for the English. Continuing undeterred, the longbowmen in the centre hammered stakes into the ground, fortifying their position in a tactic learned from previous conflicts in the war. At 11am, on the king's order, the archers opened up. In response, the French cavalry charged, followed by men-at-arms.

The longbowmen first shot galling arrows to purposely wound and disorientate the French ranks before switching to standard bodkin-point arrowheads. The combination of the narrow, muddy battlefield and the severely undermanned charge saw the French knights slaughtered by the hail of English arrows, as their frightened and injured horses became uncontrollable. Any horses that got even remotely close were impaled on the stakes, and any that turned back crashed into the oncoming men-at-arms, blunting the attack. With the battleground now even more churned up by the horses' hooves, the foot troops moved forward painfully slowly. The area was so narrow that the French crossbowmen and artillery could not support their now-isolated foot soldiers, as a wall of arrows struck the exhausted infantry.

The French attack had just enough momentum to reach the enemy ranks, and at first the English line began to buckle under the strain. Knowing that leaving the narrow battlefield would result in annihilation, the English rallied as the longbowmen dropped their bows and took up swords and axes. The French men-at-arms were protected by thick plate armour, but the nimble archers had purposely shortened their swords and lances, and would slash at any unprotected area, while the huge amount of French troops struggled to swing their powerful broadswords effectively. The lines were such a mess that fallen troops were crushed down into the mud,

In the French ranks, nobles jostled for space so they could have their coat of arms displayed at the battle. The result was a chaotic mess

unable to rise up again due to exhaustion and the 50-kilogram (110-pound) weight of the armour. Any Frenchman who fell drowned in the mud as his fellow soldiers trampled over him.

Within 30 minutes of fighting, two of the three French lines had been completely destroyed. The duke of Alençon lay dead in the mud as did the French commander d'Albret. On the English side, the dukes of York and Suffolk had been killed, but Henry was still alive and so was his brother, the Duke of Gloucester, whom Henry had defended valiantly in the heat of battle.

Failed encirclement

Having witnessed the carnage, the decision was made for Isambart d'Agincourt and Robert de Bournonville, men with local knowledge, to target the rear of Henry's army. It was here that French prisoners the English had captured during their invasion were located. A small force of peasant fighters and knights quickly overwhelmed the limited English defenders and plundered the English camp, taking horses and even a royal crown in the process.

Enraged, and also concerned at the possibility of a mass French counterattack, Henry ordered the killing of all his prisoners except only the highest-ranking nobles. The English men-at-arms refused, as this would clash with their chivalric code, so the archers took on the job, killing them in cold blood. There were more prisoners than men in the whole English army, so this knee-jerk reaction was effective in nullifying any possibility of an uprising but severely lessened the opportunities for ransom after the battle.

***Below:** Unlike many of their counterparts, English men-at-arms and knights fought on foot*
***Below, right:** It is thought that Henry ordered a service of thanksgiving on the battlefield after the English victory*

"THE ENGLISH MEN-AT-ARMS REFUSED TO SLAY THE PRISONERS AS IT CLASHED WITH THEIR CHIVALRIC CODE, SO THE ARCHERS TOOK ON THE JOB, KILLING THEM IN COLD BLOOD"

On the frontline, a 600-man counterattack led by the Counts of Marle and Fauquemberghes had been a disaster. This setback was the final straw, and the remaining French line withdrew. 8,000 French (including one third of the nobility present at the battle) had been killed while the English dead only numbered in the low hundreds. Against all the odds, the English had won the battle.

Aftermath

Ecstatic after their victory, the English broke into song, chanting early versions of the *Agincourt Carol* and other traditional celebratory tunes. The series of French mistakes had proved fatal and the location of the battle had essentially forfeited their numerical advantage. If the full strength of the French cavalry had charged at the English, even the skilled longbowmen, who could fire up to six arrows a minute, and the courage of the men-at-arms wouldn't have been able to hold them off.

Henry's army sacked the French camp and stripped the dead of everything of worth as soldiers fled in all directions. That night, the king held a banquet in nearby Maisoncelles, which was served by captured and now-humiliated French knights. After the emotion of the victory had died down, the weary men were unable to march on Paris, voicing concerns over a lack of siege weapons, and they withdrew back to the safety of Calais on 29 October. Despite the unlikely victory at Agincourt, minimal territory had been gained and Charles VI was still in power, but the French military had been broken on the field. Harfleur was now an English-controlled town and would be an effective launching pad for Henry's second invasion of Normandy in 1417. Burgundy, meanwhile, still refused to strike a deal with the House of Valois, as the French kingdom's enemies began to stack up.

Despite the gains, Henry sailed back to England after his nobles voiced fears over the possibility of a costly winter campaign. He returned to a hero's welcome, and after a few more years of successful campaigning, would draw up the Treaty of Troyes in 1420, recognising him as regent and heir to the French throne. The failures of Agincourt had made the French hesitant to fight pitched battles, which contributed to English victories at the 1416 Battle of the Seine and the 1418 siege at Rouen.

Henry's French conquests were successful, but the strain on his kingdom's finances was beginning to tell and would eventually signal the beginning of the end for the Lancastrian monarchy in his later years.

The king died in 1422, meaning he never officially became the king of France. After his sudden death, English fortunes on the continent took a turn for the worse, and when the Wars of the Roses broke out in England, the control of France slipped from the new teenage king Henry VI. The famous victory at Agincourt was now in the past and the era of Joan of Arc and the return of French military power was at hand.

ROYAL STRATEGY

DR MATTHEW BENNETT DISCUSSES THE KING'S COMMAND AND THE FRENCH HESITATION

Dr Matthew Bennett recently retired after a full career as senior lecturer at The Royal Military Academy Sandhurst. He is a medieval military historian and contributed the battle account in the catalogue for the Agincourt 600 exhibition at the Tower of London. His publications include *Agincourt: Triumph Against The Odds* (Osprey, 1991) and several specialist studies of English archery tactics used in the Hundred Years' War.

How did Henry V's campaign plan in 1415 differ from Edward III's Crécy campaign in 1346?
There is no doubt that Henry was inspired by the achievements of his great-grandfather. Edward had invaded Normandy via the Cherbourg peninsula, sacked Caen and advanced to just north of Paris, challenging the French king to battle. He then withdrew northwards to Poitou where he was victorious at Crécy. The following year he besieged the bridgehead port of Calais. In contrast, Henry landed at Harfleur, in the mouth of the River Seine, capturing it after a bitter siege and then marched to Calais.

Was the planned expedition popular at court and among the nobility?
Generally, the war against France, fought *in* France, was desirable to the military aristocracy because it offered opportunities for glory, plunder and lands. Richard II's unpopular peace policy had been an important factor in Henry Bolingbroke's 1399 usurpation. Young Henry had proved his valour in his first battle at Shrewsbury in 1403, aged only 16, where he was wounded in the face by an arrow. As king, Henry V won support from the nobility, but also the financiers of the City of London, and its lord mayor, Richard Whittington, who recognised a good investment.

How did the long siege of Harfleur affect Henry's objectives and plans?
The 12,000-strong English army landed in mid August and a month-long siege ensued. The garrison was a bare 300 men, but the town of Harfleur was well fortified by walls and 24 towers, together with ditches and a moat on the seaward side. Siege artillery, both gunpowder and traction, pounded the main gate, which was protected by a wooden bulwark. The unsanitary conditions of the siege lines caused an epidemic of dysentery, which killed or incapacitated some 2,000 of the English, including its leaders. When Harfleur finally surrendered on 18 September, it seemed that Henry's plans had suffered a serious check.

What should we make of the story that Henry originally intended to march south to Bordeaux and Guyenne, and what would have happened had he done so?
The English Crown also held lands in Aquitaine, so marching south would have emphasised the link with these ancient possessions. However, it was late in the year for campaigning and it would have required significant logistical support. Known as a chevauchée, such expeditions could have a symbolic effect, but in the latter years of Edward III's reign, there had been several disastrous attempts of this nature. The French had learned not to confront English armies, but to harry them and deny them provisions, so the risk for Henry was too great.

Why did Henry march on land to Calais rather than take a safer passage by sea?
This was indeed the question that Henry's chief advisers asked the king! They feared that the English army would be caught 'like sheep in fold' as French forces combined against it. The answer must be that Henry was making a statement about his right to march wherever he wanted in a country he claimed that he had the right to rule. He may also have contemplated winning a decisive action against the French, as Edward had done 69 years earlier.

Were there any skirmishes with the French en route to Agincourt? If so, were any of them significant?
The French, who had not attempted to relieve Harfleur, merely shadowed the English line of march when the army set out. They relied on blocking the bridges and fords of the River Somme. Faced with this obstacle, Henry was forced to lead his men south east, away from the direct route to Calais, and the English supplies soon ran out. He did manage to cross near Péronne, which was a week's march from his destination, but the French still avoided combat.

Left: An English Henry V halfpenny. Henry's campaign put a strain on the finances back in England

Right: Dr Matthew Bennett regularly lectures about medieval warfare

Did Henry ever consider cutting his losses and turning back? Were there any mutinies or desertions?
The sources do not really provide an answer. In the light of the stunning victory at Agincourt, any dissension may have been written out of the record. The churchman who wrote an eyewitness account of the campaign, *The Deeds Of Henry V*, does admit that the soldiers were often uncertain and frightened. However, the king kept strict discipline, enforcing regulations and hanging pillagers. Also, the risk of leaving the army and being at the mercy of the enraged French peasantry was probably greater than keeping together.

Why were the French, with a much larger army and home advantage, so hesitant to engage the English?
This is the key question. First, French strategy remained non-confrontational. Second, they hoped to wear the English down before challenging battle. Third, it may be that they did not actually have a huge advantage. This is certainly the argument of Professor Anne Curry in her book *Agincourt: A New History*. Her study of the English documentary records indicates that the army may have been 9,000 strong. In contrast, France was in the midst of a civil war, with a mad king and rival Burgundian and Armagnac factions. Their commanders were bitterly divided and it may be that all their forces did not come up to fight. They had a greater number of fully armoured men-at-arms, but their botched battle plan meant that they failed to utilise them effectively.

What sort of condition was the English army in on the eve of Agincourt?
The English set out with a week's rations, but had been on the road for 16 days. They had subsisted on nuts, berries and dirty water. Anne Curry points out that although no source states that they were suffering from diarrhoea, it seems likely. The archers are described as rolling down their hose (leg coverings) to the knee. This strongly suggests that their bowels were running. They may well have been weakened, but they were both desperate and inspired by a charismatic leader, which was enough to win the day.

Images: Alamy; Getty; Thinkstock

Great Battles

KALKA RIVER

Subutai, Genghis Khan's second in command, faces Russian nobility, composite bow in hand

KALKA RIVER, RUSSIA 31 MAY 1223

WORDS MARC G DESANTIS

OPPOSING FORCES

MONGOLS

LEADERS:
Subotai Bahadur & Jebe Noyon

OVERALL:
20,000, all cavalry

VS

RUSSIANS

LEADERS:
Prince Mstislav of Galicia; Prince Daniil Romanovich of Volhynia; Grand Prince Mstislav Romanovich of Kiev; Khan Koten of the Kipchaqs; plus several other commanders

OVERALL:
80,000 cavalry and infantry; only approximately one quarter were trained soldiers

The figure of Genghis Khan of the Mongols looms like a colossus over the whole history of the Middles Ages, in both the east and west. With an army that displayed unsurpassed mobility and tight coordination, he established one of the largest land empires ever, conquering vast territories in a short space of time. His empire also proved durable, being able to survive his death and division among his heirs for some two centuries or more in places.

Genghis's beginnings hardly boded well for the future world conqueror. Born around 1162 and called Temujin in his youth, at the age of 12 he became the head of his household when his father was slain by rival Tatars. His father's erstwhile Mongol supporters would not consent to follow a boy, and his family, consisting of his mother and his brothers, experienced hard times. For safety they hid in the mountains, and Temujin sustained them through hunting and fishing. His early life was extremely difficult, but it toughened him. He also gained warrior followers of his own and married a woman named Borte. When his wife was carried off by Merkit raiders, Temujin daringly rescued her from her captors.

Temujin allied himself with Togrul, khan of the Keraits, and with him took revenge on those who had killed his father, ruthlessly crushing his blood enemies, the Tatars. Eventually he and Togrul quarrelled and Temujin was driven far away, with just a handful of his followers remaining. The powerful coalition that the Keraits had put together, however, soon disintegrated and Temujin, now calling himself Genghis, returned for a rematch. He smashed the Keraits and Togrul fled. With their old khan out of the picture, the surviving Keraits willingly accepted Genghis as their new khan.

"GENGHIS BELIEVED HE HAD A DIVINE MISSION TO UNITE ALL OF THE MONGOL PEOPLES, AND THIS MISSION EVENTUALLY EXPANDED TO INCLUDE THE WHOLE OF THE WORLD"

Genghis methodically set about bringing all of the tribes of the Mongolian steppes under his rule. In 1206 he held a great assembly, or kuriltai, where he was declared the supreme khan of all the Turkic and Mongolian peoples. Genghis believed he had a divine mission to unite all of the Mongol peoples, and this mission eventually expanded to include the whole of the world.

Grand Prince Mstislav of Kiev is taken captive and his forces slaughtered following their surrender to the Mongols

Between 1207 and 1209, nearby Turkic tribes were pulverised and the sedentary kingdoms of northern China, the Xi Xia and the Jin, were attacked. The Xi Xia capitulated but the Jin, notwithstanding the sacking of their capital at Beijing in 1215, successfully resisted the Mongols from behind the walls of their well-fortified cities and towns. Mongol siegecraft was still very limited in its capability at this time, so Genghis turned his sights elsewhere for the time being.

After crushing the Qara Khitai in the west, Genghis mounted a major invasion of the Islamic world. His first target was the wealthy Central Asian state of Khwarezm in Transoxania. Using the murder of Mongol merchants and ambassadors as a pretext, Genghis invaded in 1219. The Khwarezmians had the larger army, but the Mongols moved much faster, aided by the peerless mobility provided by their hardy steppe ponies. Cities were taken by the Mongols one after another, and their inhabitants butchered. The cities were then set alight.

It was the same horrifying story as the Mongols continued their march into what's now Afghanistan and eastern Iran. The Mongols were especially adept at using terror as a weapon against their enemies. The sheer fright they induced in others as a result of their deliberate terror tactics often prevented further effective resistance from developing against them. The death and destruction that Genghis's soldiers wreaked as they carved their way through Khwarezm, which fell in 1221, was ghastly. There's good reason for Genghis's reputation as a bloody-handed destroyer. An English monk, Matthew Paris, later wrote harshly of the Mongols: "They are of the nature of beasts... they thirst after and drink blood." Other lands would soon know the unspeakable cruelties of a Mongol invasion. Northern India was brutally attacked, and by 1223 a powerful Mongol army had appeared on Russia's frontier to conduct a massive reconnaissance raid against Europe.

The Russia that the Mongols attacked was a far cry from the giant empire of the tsars it would later become. The Russian state had gotten its start in the 8th century CE with the settlement of the Varangian Rus – Scandinavian Vikings who used the numerous rivers of western Russia as highways to travel to and conduct trade with Byzantium far to the south. The Rus eventually put down roots, with one Northman, Rurik, and his two brothers becoming overlords of the Slavic tribes in the region. The Rus thus bequeathed their name to what would become Russia.

In the north, the foremost Russian city was Novgorod. In the south, it was Kiev. The Scandinavian Varangians became Slavicised as they intermarried with the local tribal peoples. Towards the end of the 9th century, the pagan Russians started converting to Orthodox Christianity under the tutelage of Byzantine missionaries. Prince Vladimir I of Kiev was baptised a Christian in 988 and made his people convert to the new faith. This earliest Russian state, that of Kievan Russia, would develop steadily over the next few centuries, expanding but also remaining weakened by divisions among its leading princes, who regularly feuded among themselves.

"WITH AN ALL-CAVALRY ARMY CONSISTING OF SOME 20,000 RIDERS, SUBOTAI AND JEBE RODE HARD NORTHWARD THROUGH THE CAUCASUS. WHAT FOLLOWED WOULD BECOME THE GREATEST CAVALRY RIDE OF ALL TIME"

By 1221 the Khwarezmian Empire had been shattered, but its fugitive shah, Ala al-Din Muhammad, had eluded the Mongols and made his way west. Two of Genghis's close comrades and leading generals, Subotai Bahadur and Jebe Noyon, both of whom had just finished destroying the Khwarezmian state, had followed after him. After making certain that the shah was dead, Subotai had the idea of conducting a massive reconnaissance raid, with the goal of learning what was to be found in Europe, a land scarcely known to the Mongols at this time. With an all-cavalry army consisting of some 20,000 riders, Subotai and Jebe rode hard northward through the Caucasus. What followed would become the greatest cavalry ride of all time, led by formidable men of extraordinary military prowess. Years later, in 1247, Giovanni di Plano Carpini, a Franciscan monk, would travel to the distant Mongol court. He concluded that Subotai was "a soldier without weakness". The Mongols themselves knew him as 'Subotai the Unfailing'. It would later be said of Subotai, after his death at the age of 73 in 1248, that in his long military career he had conquered 32 nations and had been victorious in some 75 pitched battles. These are astonishing achievements, and they highlight the quality of the general to whom Genghis had entrusted the western campaign. He had chosen his man well: Subotai was not just an adept military leader, he was also famously loyal to the Great Khan, once saying to his master, "As felt protects from the wind, so I will ward off your enemies."

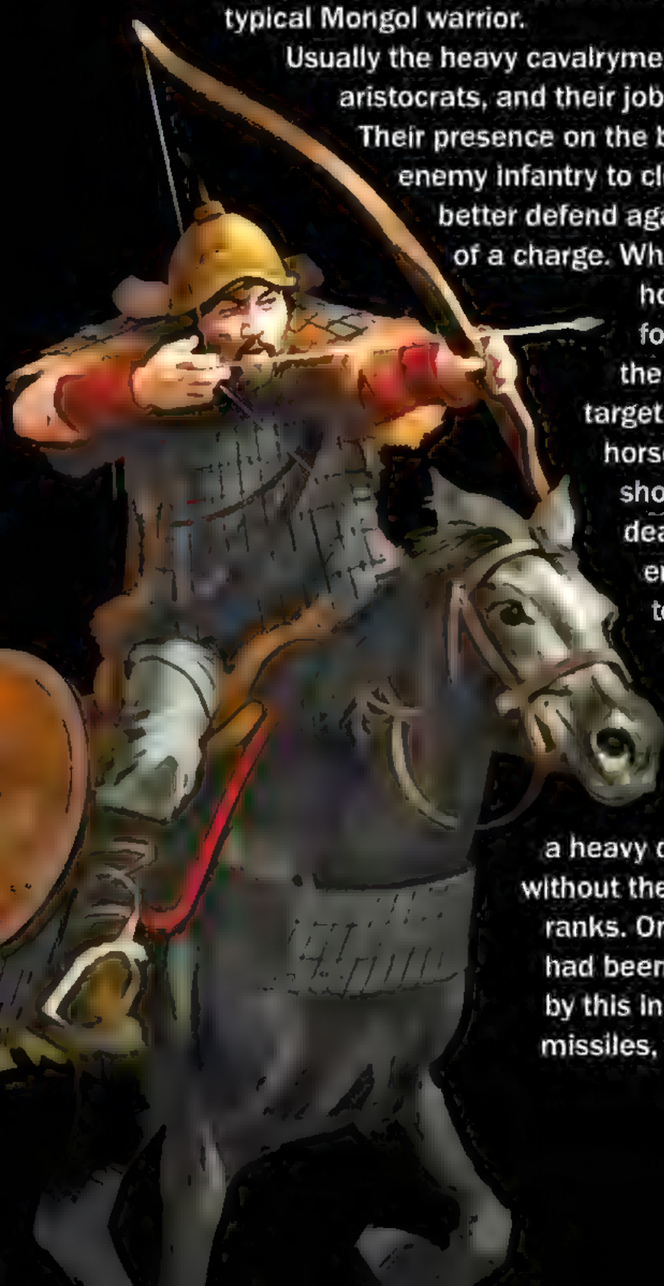
A depiction of the one-sided battle on the Kalka River. The Mongol cavalry attacks the allied force's disorganised soldiers

MONGOLS AT WAR

THE HORDE RELIED ON THE IRRESISTIBLE COMBINATION OF HARDY STEPPE PONIES AND POWERFUL COMPOSITE BOWS

Subotai had at his command the perfect force with which to mount this daring raid. The Mongol army of Genghis's day was without doubt one of the most formidable in the history of the world. Its might owed much to its tactical and strategic coordination. The Mongols carefully organised their horsemen into mingghans, or regiments, of 1,000 men and, at Genghis's own direction, into much larger tumens, or corps, of 10,000 men. Coordination of these units, even when separated by long distances, was impeccable.

Mongol battle tactics were in line with standard methods of warfare practiced by Eurasian steppe nomads for many centuries. Most Mongol warriors were horse archers, being only lightly equipped, bearing just a bow and wearing little or no armour. These were backed up by a small but hard-hitting corps of heavily armoured Mongol cavalry. These elite horsemen carried spears, swords and maces as their primary weapons, and both man and horse were clad in lamellar armour composed of small, stitched-together iron plates. Very cleverly, they also wore silk shirts underneath their armour. When an enemy arrow penetrated, the silk conformed to the arrowhead, making extracting the missile easier and safer. Often, the greater injury was done to a man not by the initial impact of an arrow, but when the attempt was made to pull the barbed arrowhead back out through his flesh. The silk shirt alleviated this problem to a degree. A small buckler-type shield and lasso rounded out the panoply of the typical Mongol warrior.



Usually the heavy cavalrymen were tribal aristocrats, and their job was multifold. Their presence on the battlefield forced enemy infantry to close ranks to better defend against the threat of a charge. When bunched up, however, the enemy footsoldiers made themselves easy targets for Mongolian horse archers, who showered them with deadly arrows. If the enemy decided to adopt a looser formation to escape this rain of death, they would expose themselves to a heavy cavalry charge without the benefit of serried ranks. Once the opponent had been softened up by this incessant hail of missiles, with many dead and the survivors' morale wavering, the Mongolian armoured cavalry, screaming war cries, would charge home to deliver the death blow with a powerful charge.

A Mongol's iron helmet dating from the 12th century, at the time of the Golden Horde

"THE MONGOL WAY OF WAR WAS A POTENT COMBINATION THAT PROVED IRRESISTIBLE FOR MANY YEARS"

The bow was the Mongol warrior's mainstay weapon, and the success of Mongolian armies would have been unthinkable without it. Unlike the Welsh/English longbow that won outstanding fame at the battles of Crécy, Poitiers and Agincourt, the Mongolian reflex bow was of composite construction, made from glued bamboo, sinew and yak horn. When strung, the bow was stressed against its curve, allowing for the storage of a large amount of energy when the bowstring was drawn. The weapon was compact, powerful and well-suited to use on horseback. A typical Mongol warrior would carry two or three such bows with him on campaign. To protect the precious weapon from the elements, it was stored in a bowcase when not in use.

Arrows would fall upon the opponent in unrelenting torrents during battle, with the great majority being launched from horseback. In combat, the Mongols utilised the superior mobility that their horses granted them. Often they would encircle an opponent, the horse archers would dart in, loose their arrows and then gallop away. This was kept up with wave after wave of mounted archers, each one riding in, shooting and then being replaced by another. The effect was to keep up an incessant rain of arrows, allowing the foe no respite. The horse archer came prepared for extended combat, bringing some 60 arrows into battle with him. Half had narrow tips for better penetration, while the other 30 had broader heads for close-range use.

Movements over large, strategically significant distances were made possible by the large numbers of horses the Mongol army contained. Each warrior brought as many as ten mounts with him, changing to a fresh one as required.

The Mongolian steppe pony was a small beast but extremely hardy. Unlike European warhorses, which required expensive, high-quality fodder, the steppe horse could subsist on the grass it found at its hooves and needed to drink water just once per day. It required no horseshoes, and was a docile beast too, not prone to straying, with legendary endurance. One report claimed that a Mongol horse could cross 950 kilometres (600 miles) in only nine days. When ridden, it bore a high-backed wooden saddle that allowed the horseman a very stable seat from which to shoot arrows.

One of the Mongols' more effective tactics was the perennial nomad cavalry standby, the feigned flight. Once engaged in battle with an enemy, the Mongols would pretend to flee the field. The opponent, considering a retreating enemy to be a beaten enemy, would very often pursue, confident that victory was at hand. Yet this was all a ruse. The Mongols were not really fleeing at all, just pretending to do so. The purpose of the feigned flight was to lure the enemy out of a defensive stance, to induce them to break ranks and give up the protection of ordered lines. The Mongols would then quickly return to the fray and cut down the surprised and now-disorganised pursuers.

Altogether, the Mongol way of war was a potent combination that proved irresistible for many years. Just why the Mongols, who were themselves only employing the same suite of tactics that steppe nomads had practised since time immemorial, were so much more successful than nearly all of their predecessors, is hard to say with any certainty. At root, the explanation must lie not with the tactics, which themselves differed in no substantive way, but with the people who practised them. The Mongols themselves were different from earlier steppe peoples because they had been united into a powerful tribal confederation by Genghis Khan. Khan took the previously disparate tribes, each composed of hardened warriors, and welded them into an effective fighting force led by excellent generals.

Great Battles

KALKA RIVER

RUSSIAN CAVALRY

The hard core of every Russian prince's army at Kalka was his druzhina bodyguard of heavy cavalry. They were equipped much like European knights, with swords, maces, axes, lances and mail armour.

KIPCHAQS

The Kipchaqs, also known as Cumans, were a Turkic people who dominated the Eurasian steppe prior to the Mongol invasion of Russia. In 1223 they joined the Russians in the disastrous Battle of the Kalka River against the Mongols.

SUBOTAI

Known as 'Subotai the Unfailing' by the Mongols, the illiterate Subotai was Genghis Khan's greatest and most trusted general. His 8,850-kilometre (5,500 mile) cavalry raid around the Caspian, through eastern Europe and back to Asia, over three years, is the longest cavalry ride of all time.

MONGOL CAVALRYMEN

Stellar horsemen, Mongol cavalrymen combined the power of their bows with the unsurpassed mobility of their hardy steppe ponies.

GENGHIS KHAN

The youth known as Temujin grew up to become the greatest and most infamous conqueror in history. In 1206, at a great steppe nomad assembly, or kuriltai, he was proclaimed the ruler of "all the tribes who live in felt tents".

07 THE END

Subotai promises the thirsty Kievans that no blood will be shed if they surrender, but once the Kievans have left their wagons, many are slain and the remainder enslaved. Noble prisoners are placed under wooden planks, suffocating to death as the Mongols sit atop them, enjoying a victory feast.

01 THE ALLIES ARRIVE

After a nine-day march from the Dnieper River, the combined army of the Russian princes and Kipchaqs arrives at the Kalka River on 31 May 1223. Little do they suspect that Subotai has deliberately lured them away from the Dnieper, by means of a false retreat, expecting that the divisions of the large army will become dispersed as it marches.

"SUBOTAI ORDERS A GENERAL ATTACK. THE RUSSIANS ARE UNREADY FOR THE ASSAULT. THERE IS NO OVERALL COMMANDER TO DIRECT THEM AND THEY HAVE LITTLE IDEA WHAT THE MONGOLS ARE UP TO"

KALKA RIVER

VOLHYNIANS

KIEV

CHERIGOV

JEBE

SUBOTAI

GALICIANS

KIPCHAQS

06 KIEV'S LAST STAND
The warriors of Kiev, watching the disaster on the far side of the Kalka River unfold before their eyes, circle their wagons, forming a makeshift fortification. They trundle slowly back towards the Dnieper over three days, under constant Mongol attack. Having depleted their drinking water, the helpless Kievans negotiate a surrender.

05 CHERNIGOV ROUTED
The leading division of the army of Chernigov, under the command of Prince Oleg of Kursk, is ready to fight in proper battle order but is defeated by the Mongols and flees. The rest of the Chernigov army, which has not had sufficient time to finish crossing the Kalka, is carried away by the fleeing masses of Volhynians and Kipchaqs.

02 RIVER CROSSING
The Kipchaqs, heading east, cross the Kalka, followed by the Volhynian cavalry and the men of Galicia. The troops of Chernigov fall behind, crossing the river only slowly. The men of Kiev at this time do not attempt to cross at all.

03 SUBOTAI STRIKES
Seeing that the major elements of the allied army have become widely separated, Subotai orders a general attack. The allies are unready for the assault. There is no overall commander to direct them and they have little idea what the Mongols are up to. In a departure from usual Mongol tactics, Subotai sends in his heavy armoured cavalry first, instead of leading the assault with horse archers.

04 ROUT OF THE KIPCHAQS
The Kipchaqs are quickly routed by the Mongol heavy cavalry. Mongol horse archers next attack the Volhynian cavalry of Prince Daniil, showering them with arrows and charging home with spears. The Volhynians flee before the Mongol onslaught. Prince Mstislav of Galicia readies his men for battle, but the headlong flight of the Kipchaqs and Volhynians sweeps the Galicians along with them towards the Kalka.

MONGOL EMPIRE

PRINCIPALITY OF KIEV
PRINCIPALITY OF GALICIA-VOLHYNIA
PRINCIPALITY OF CHERNIGOV
PRINCIPALITY OF SMOLENSK
KIPCHAQS

Map: Rocio Espin

Genghis, from the beginning a shrewd judge of ability, was also not above taking a former enemy into his service when he saw talent in him. Jebe, Subotai's co-commander on the raid, was a member of the Yesut tribe of Mongols, and had earlier battled his new master during the tribal wars that saw Genghis, then still known as Temujin, cement his authority over all of the Mongol peoples. In one encounter, Jebe had even managed to bring down Genghis's own horse. When he was later captured, he anticipated nothing more than being put to death. Instead, Jebe was taken into Genghis's service and became one of the Great Khan's highest-ranking generals.

The ride began in February 1221 with Subotai circling his army around the southern end of the Caspian Sea. After crushing the Christian Kingdom of Georgia that year, the following year Subotai was confronted by a coalition of peoples in the Caucasus, including Alans, Iasians and Kosogians, which sought to block his passage. The coalition was led by the Kipchaqs, a Turkic people who dominated the steppes of what is today southern Russia and Ukraine. Subotai found himself trapped in the mountains on terrain that did not favour Mongol cavalry tactics. Destruction loomed until Subotai, employing brains rather than brute force, bribed the Kipchaqs to leave. Once they had departed he fell upon the abandoned Caucasians and annihilated them. The Mongols then moved on to the Ukrainian steppe, hard on the heels of the unsuspecting Kipchaqs, and smashed their army in a battle near the Don River then sacked the city of Astrakhan.

After spending the winter of 1222-23 out on the steppe north of Crimea conducting reconnaissance of the region, Subotai began to advance westward in earnest, pushing along the Dniester River towards the Russian heartland, slaughtering all in his path. The frightened Kipchaqs warned the Russians that if they did not receive Russian aid then they might very well be forced, by dire circumstances, to join with the Mongols. The Russians had long-suffered raids by the Kipchaqs, who were themselves steppe nomads with a fondness for preying upon the settled peoples around them, and so for much of the past year they had steadfastly refused the entreaties of the Kipchaqs. Now, however, with the Mongols threatening both peoples, an alliance to fight the common enemy was made, and preparations for a joint war began. Several Mongol ambassadors, who had come seeking peace, were summarily executed. The next group of Mongols to appear did so only to deliver a formal declaration of war.

Around 18 Russian princes, together with the Kipchaqs, formed a large army of some 80,000 men, and together marched eastward to confront the invaders. Among those taking part in the expedition were Mstislav Romanovich, Grand Prince of Kiev; Daniil Romanovich, Prince of Volhynia; and Prince Mstislav of Galicia, plus a number of other princes. They were joined on the expedition by the Kipchaqs under Khan Koten, who was also the father-in-law of Mstislav of Galicia. Worryingly, just 20,000 of the troops they led were properly armed and trained to fight.

"WITH THE MONGOLS THREATENING BOTH PEOPLES, AN ALLIANCE TO FIGHT THE COMMON ENEMY WAS MADE"

While the bulk of the Mongol army now moved east, heading away from Russia, a small rearguard of 1,000 Mongol horsemen was left behind to delay the Russian-Kipchaq advance. Control over the huge allied army was less than ideal. Assembling at the Dnieper River on 22 May 1223, the Russian crossing was severely hindered by the distrustful princes' bickering over who should be the supreme commander of the combined army. In many ways the massive host was a collection of several smaller armies, not a single, united force. The heavily outnumbered Mongol rearguard was destroyed once the Russians had at last crossed, but only after it had inflicted significant casualties with its deadly archery.

Subotai and Jebe were in fact drawing the Russians ever further from the Dnieper, luring them onto territory they had already scouted. They were engaged in a false retreat on a strategic scale. It was the Mongols' preference to destroy an enemy's field armies outside of its frontiers and far away from any fortified strongholds, before plunging deep into the defenceless territory. They also knew that the allied army lacked a supreme commander, and so its major units would inevitably become separated as some moved ahead faster than others. Subotai allowed them small,

Men from the Golden Horde demand tribute from Russian villagers in the 13th century

meaningless victories against token forces to encourage them to continue the chase. This lasted for nine days after the crossing of the Dnieper and the allied army, as the Mongols expected, did indeed become dangerously attenuated over the course of the march, stretching out some 80 kilometres (50 miles) from nose to tail.

Disaster at the Kalka River

On 31 May 1223 Subotai chose to make his stand on the small Kalka River, in what is today Ukraine, and struck first, just as the pursuing allied army was in the middle of crossing the river. Showing his military flexibility, Subotai decided not to begin the battle with the showers of arrows launched by horse archers, as was typical practice among the Mongols and other steppe nomads, but instead sent in his heavy armoured cavalry first. This cavalry charge, delivered at the outset of the battle, proved decisive. The Mongols immediately engaged the Kipchaqs in close combat and soon ran them off. The armoured cavalrymen's next targets were the Russians from the Principality of Volhynia. They too were routed.

The unengaged Russians of Galicia saw what was happening and tried to form a battle line, but they were carried away by the tide of fleeing Kipchaqs and Russians that once formed the advance guard. The men of Chernigov were caught in the midst of their own river crossing and were also carried away by fleeing allied troops. Elsewhere, Prince Oleg of Kursk put his men into a semblance of order, but these too were defeated by the irresistible Mongols.

"KEEPING TO THE STRICT LETTER OF HIS WORD, SUBOTAI SAW TO IT THAT THE RUSSIAN ARISTOCRATS' BLOOD WAS NOT SPILLED. INSTEAD THEY WERE SUFFOCATED BENEATH WOODEN PLANKS WHILE MONGOLS FEASTED ATOP THEM"

The 10,000 men of Kiev under Prince Mstislav Romanovich circled their wagons and defended themselves well for several days as they tried to make their way back west to the Dnieper. Having run out of drinking water on the steppe, they surrendered, as Subotai promised that no blood would be spilled and that they would eventually be released upon the payment of a ransom.

The Battle of the Kalka River was over, but the misery for the Russians was not yet at an end. The Mongols killed many of the capitulating Kievans outright and took the rest of them captive. Keeping to the strict letter of his word, Subotai saw to it that the Russian aristocrats' blood was not spilled. Instead they were suffocated beneath wooden planks while Mongols feasted atop them, in an act of revenge for the deaths of their ambassadors before the war had commenced. All told, it was reported that some 90 per cent of the allied army met its end by the Kalka. Of the 18 Russian princes thought to have participated in the expedition, a dozen lost their lives. Subotai and Jebe's Mongols, however, suffered minimal losses in the battle.

For now, the Mongols were not in Russia to stay. Subotai was soon summoned back east by Genghis to conduct another mission. With the successful conclusion of Subotai's great cavalry raid, the victorious nomads returned to the deep Eurasian steppe. To the mauled Russians, they seemed to vanish into thin air, making them seem more like supernatural demons that had come to terrorise the world.

The Mongols would, however, return in 1237, and this time they meant to make their presence permanent. The Russians were again smashed, and the Mongols inaugurated a period of harsh overlordship known as the Mongol Yoke. The Russians suffered terribly and were forced to pay heavy tribute to the masters from the steppe. Economic development in the country came to a complete halt, and only at the end of the 15th century did Mongol domination in Russia end for good.

The all-cavalry Mongol force had a distinct advantage over the sprawling, slow-moving allied army

Images: Alamy, Rocio Espin, FreeVectorMaps.com, Getty, TopFoto

THE PREMODERN ERA

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THE TRANSFORMING TOOLS OF WAR

How cannon, shot and the evolution of the blade transformed 300 years of warfare and changed the offence and defence of civilisation forever

WORDS **DOM RESEIGH-LINCOLN**

Throughout the annals of history, war remains a constant. In warfare, empires have been forged and torn down. Nations have expanded, and been driven back. Entire civilisations have risen, and imploded, through the engines of blood, victory and defeat. And so, like any catalyst for change, warfare has evolved and transformed across the ages, with myriad cultures creating, adopting and enhancing countless weapons to carry into combat.

As the western world emerged from the shadow of the Middle Ages and into the 16th century, its weaponry and warcraft had been transformed by an era of close-quarters combat, cavalry charges and plate armour. Swords, much as during the early medieval period, were still a mainstay on the battlefield, with many of the classic medieval designs continuing to appear in recorded combat. Longswords, for instance, remained in use right up to around 1550, despite the decline of military knighthood. These 'hand-and-a-half' tools were prized for their deadly accuracy and the high level of skill needed to wield them.

The side-sword also saw far greater prominence at the end of the Middle Ages and into the beginning of the Early Modern era. Considered a direct evolution of the classic arming sword used by countless nations from the reaving Vikings of Scandinavia to the legions of Rome, this versatile one-handed weapon saw countless variations appear. The Renaissance of Europe saw many warriors now placing a finger on the ricasso (an unsharpened length of metal just above the hilt), which led directly to the rise of the civilian rapier.

The sword was no longer seen as a heavy and cumbersome tool designed for swinging and stabbing, but a lighter and more versatile weapon geared towards finesse rather than brute strength. Falchions (which were a western iteration of the Persian scimitar) were also still popular up until the 16th century, serving as a cross between a side-sword and a dagger, and typified by their curved blade at the tip. Both side-swords and rapiers remained popular side by side for years, with the use of bucklers (small shields) helping popularise the term 'swashbuckle'.

In the East, particularly in Japan, where the Edo Period saw the nation's warfare hold steadfast to traditional combat methods, swords remained a pillar of battle technique despite the widespread adoption and production of firearms. The katana – wielded by the highly skilled samurai – was favoured due to how quickly it could be drawn in battle, with the Kotō ('old sword', popular towards the end of the 1500s) making way for the sleeker blades of the Shintō ('new sword') and the Shinshintō ('new new sword') in the centures that followed. Melee weapons were also very popular over in China during this era, with jian (short swords) and hooked glaives known as dao remaining in use right up to the end of the 17th century.

In Europe, swords soon transitioned from a vital tool of war to something that was both ceremonial and fashion-orientated. The popularity (and the rising affordability) of firearms reduced swords and daggers to a side-arm at best. By the 18th and 19th centuries, swords were mostly worn by officers as a sign of status, while simple blades known as bayonets were affixed to the end of muskets and rifles in order to transform them into melee weapons when a soldier had run out of shot.

Ranged weaponry was transformed between the start of the 16th century and the end of the 19th century as the bow slowly began to lose its dominance. Firearms had first appeared in Italy in the 14th century and 100 years later in the Ottoman Empire following their genesis in China, and it was these 'hand-cannon' that served as the progenitor for the rifles and pistols that began to appear in the West during the 16th century.

Matchlock rifles and muskets were some of the first popular forms of firearm in the west, and provided a far more efficient (and automatic) means of lighting the fuse of a gun. Without the need for the exertion required by a bow, these kind of rifles enabled a soldier to use both hands in aiming and supporting the weapon. While rifles such as these were often less accurate than bows, they provided better range and damage. Matchlocks (and wheellocks) were then superseded by far more efficient lighting mechanisms in the early 17th century, including the snaplock and the widely popular flintlock.

In China, the birthplace of gunpowder, rifles soon began to replace the crossbow (which had helped partially replace the bow in its many forms) with thousands of cannon, muskets and sidearms produced during the Ming Dynasty in the mid-1600s. By the 17th century, breech-loading guns (which used a cartridge rather than a traditional mixture of gunpowder and ball) were growing in popularity, but the traditional long guns such as muskets remained in wide use as traditional plate armour became largely obsolete. Muskets served as the most common ranged weapon in countless major battles across the world, including the Napoleonic Wars, the American Civil War and many more. They would remain the norm until the rise of the repeating rifle in the 1850s, which proved far more efficient in terms of shots per reload.

As western nations entered the Age of Discovery, the need for weaponry to become

March with your rest in your hand.

March, and with your Musket carry your rest.

Unshoulder your Musket.

Poize your Musket.

Join your rest to your Musket.

Take forth your Match.

Blow off your Coal.

Cock your Match.

Try your Match.

"NAVAL WARFARE SHAPED ASIA, EUROPE AND THE AMERICAS FROM THE EARLY 1600S THROUGH THE 18TH CENTURY"

far more mobile on a larger scale became a driving factor. Ships were no longer just an armed means of ferrying travellers and warriors into battle, but roving war platforms all of their own. Developments in shipbuilding – driven by the need to travel long distances across oceans to far-off lands – saw the creation of carracks, cogs and caravel designs, which could displace around 300 tons in weight. As a result, these ships could house large armaments of cannon, turning many into mobile forts that could unleash and withstand huge amounts of damage.

Naval warfare shaped Asia, Europe and the Americas from the early 1600s right through to the mid to late 18th century, with designs such as the man-of-war (which could have up to 150 cannon onboard at once) helping England transform itself into Great Britain and one of the most powerful empires in history. Mobile warfare also enabled nations that had previously been dominated in land-based confrontations – such as the Netherlands and the rise of the Dutch East India Company – to become a new force, and once-timorous nations extended their reach and influence into the New World and beyond.

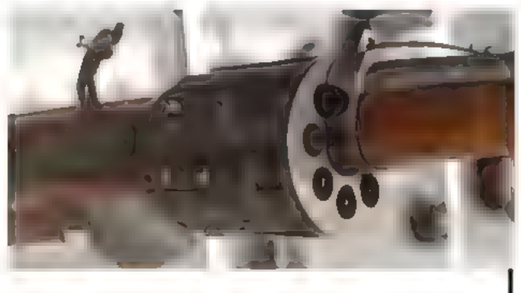
However, with the expansion of empire and trade across the world – and the inevitable conflicts that followed – weaponry designed and built for defensive purposes also changed drastically as the world transitioned from the Middle Ages right through to the dawn of the Modern era. Plate armour remained

THE RISE OF THE CANNON

The improvements in mobility and the speed with which a cannon could be loaded and fired, saw cannon play a considerable role in the outcome of the American Civil War

Much like the introduction of the catapult and the trebuchet before it, the development of the cannon transformed siege warfare, naval combat and defensive strategies. By the beginning of the Early Modern era in the 16th century, cannon had became widespread in use across Europe, the Middle East and in Asia. Developments in iron smithing enabled manufacturers to build much larger and more versatile designs, with cannon as large as over 9,000kg being used in open warfare. While cannon had been first used in China as far back as the 1300s, it was its introduction into naval combat that precipitated a new era of shipbuilding. Ships were designed to have thickened and enhanced hulls in order to hold the weight of multiple cannon, with anything from a handful to over 150 cannon placed onboard European galleons as broadside exchanges typified the age of fighting sail. The introduction of the demi-cannon in the 17th century also gave sieges and naval battles even more deadly power. A demi-cannon on a ship-of-the-line could fire a 15kg solid shot, powerful enough to penetrate a metre of solid oak.

By the late 1700s and early-to-mid 1800s, cannon were now far more mobile and considerably more accurate. Their use played a significant role in Napoleon Bonaparte's rise to power when he oversaw the defence of Paris during the French Revolution, and even led to the development of the 'Canon de l'Empereur' or the 12-pounder Napoleon. This design, along with the sleeker Griffen gun, were widely used in the American Civil War and played a deadly role in the exchange of long range fire between the North and the South.



A HISTORY OF EARLY MODERN WEAPONRY

Defining moment
REVOLVERS ARRIVE IN EUROPE
1580

Despite being most associated with the 19th century, the earliest revolver design was actually produced in China during the 16th century. When this five-barrelled spear design made its way to Europe, European gunmakers began producing wildly different looks and specifications. These revolvers were some of the earliest examples of a repeating weapon, enabling a user to fire more than one shot without the need to reload. However, most of these designs, while revolutionary, were a little too cumbersome for widespread use, and more traditional single shot firearms remained the norm.

WHEELLOCK HITS EUROPE
At the beginning of the 16th century, the wheellock is introduced in Europe, offering a more effective alternative to the traditional matchlock. It is, however, considerably more expensive to produce, so it takes a while to properly take root.
1505

FIRST CARBINE PRODUCED
Carbines are manufactured for the first time in Augsburg, Germany. This long gun firearm sat between a rifle and a pistol in terms of size, and offered moderate range and damage as a result. It proves a popular alternative to the musket.
1530

PAPER CARTRIDGES INTRODUCED
Long before the introduction of the far more reliable (but more expensive to produce) metallic casing, a new type of cartridge was produced using oxidised paper filled with gunpowder and a small bullet. Swedish king Gustavus Adolphus was one of the first to introduce them.
1611

BAYONETS FIRST USED IN EUROPE
Bayonets – a blade affixed to the tip of a rifle designed to give a rifleman the ability to charge when out of ammunition – begin appearing on European muskets. However, other nations (including the Ottoman Empire) had been using them for almost a century.
1671

PUCKLE GUN INVENTED
James Puckle, an English inventor, produces a breech-loading flintlock revolver known as the puckle gun. Affixed to a stand, this heavy firearm had a spinning cylinder that could fire 63 shots in seven minutes.
1718

The Janissaries were formed in the mid-1300s, and were fabled to be kidnapped Christian boys who were converted to Islam and trained to be elite soldiers

popular as Europe entered the Renaissance as production methods for producing steel and harnesses improved, with both infantry and cavalry wearing full plate well into the Renaissance of the 16th century. However, by the early 17th century the use of full armour declined to simple chest plates known as a cuirass.

Armour did not disappear completely, and was still worn in the battlefield, especially by commanders and generals in the West, right up until the mid 18th century. Rather than leading to its complete obsoletion, the widespread use of firearms actively kept armour smiths in business due to the deadly power of a rifle or musket. For instance, steel and iron vests were worn during the American Civil War in the 1860s, but their effectiveness varied – some were strong enough to deflect bullets or bayonets, while others offered little to no protection. In the East, armour was maintained in warfare for considerably longer, especially in Japan. The lasting influence of the samurai saw the 'modern' design of the Tosei-gusoku armour (which was introduced in the 1500s) remain in use until the decline of this warrior class in the mid-1800s.

Shields, on the other hand, declined rapidly in use following the end of the Middle Ages. Bucklers came into fashion with the appearance of the rapier in the 1600s, due to their smaller design and reduced weight. By the end of the 17th century, however, shields had mostly disappeared from use in the battlefield as firearms proved to be much faster than defending against a glancing blow from a sword. By the 19th century, with the Industrial Revolution in full swing, weaponry had become almost solely driven by the power of gunpowder, as rifles, cannon and explosives continued to shape warfare across the world.

RISE OF THE MUSLIM 'GUNPOWDER EMPIRES'

Prior to the widespread arrival and adoption of gunpowder in the region of the world we know now as the Middle East in the 16th century, warfare in the region relied mostly on cavalry and the composite bow to gain an edge on the battlefield. In fact, it took a considerable amount of time for the Ottoman Empire to finally concede that cavalry charges would often be cut to ribbons by sustained musket fire. However, once firearms were finally adopted, their use transformed the nation into a gunpowder empire and facilitated countless victories against their Persian and Egyptian rivals. The introduction of gunpowder in the 16th and early 17th century also elevated two other dynasties – the Mughal Empire (modern-day India) and the Safavid Empire (Iran) – and it would be these three powerful gunpowder empires that used firearms and cannon to turn control of the continent into a constant exchange of territory. Matchlock muskets were first adopted by the Turks, while the Persians of the Safavid Empire would become famed for their production of pistols. The Mughal Empire relied heavily on the use of artillery and other large ordnance.

Interestingly, the enhanced military training methods employed by the Ottomans enabled the nation to adopt and refine the use of firearms as an effective military tool at a much faster pace than their counterparts in Europe. The Janissaries, for example, were a crack set of infantry bodyguards who traded their use of bow and horses for muskets, and became one of the first true elite units to serve in any military.

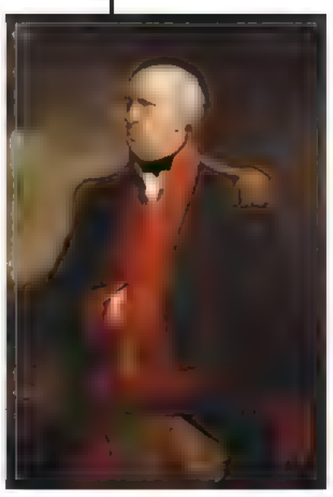
"ARMOUR DID NOT DISAPPEAR COMPLETELY, AND WAS STILL WORN IN THE BATTLEFIELD, ESPECIALLY BY COMMANDERS AND GENERALS IN THE WEST, UP TO THE 18TH CENTURY"

Defining moment
COMPOSITE BOW BECOMES OBSOLETE
1750

The composite bow, the weapon that had defined and dominated ranged warfare for both infantry and cavalry for centuries, finally became obsolete in the widespread advent of firearms. This change had been developing for decades, but by the mid-1700s the use of bows proved completely ineffective against sustained fire from infantry armed with muskets, rifles and pistols. Horse-mounted archers in particular disappeared completely as a unit. The reduction in manufacturing costs, and the improvements to loading methods, made firearms a far more productive means of waging war.

Defining moment
CONGREVE REVOLUTIONISES GUNPOWDER
1783

In 1883, Sir William Congreve, 1st Baronet, a British military officer, oversaw some major new improvements to the production of gunpowder. His experiments led to the creation of 'cylinder powder', which used a form of gunpowder made with charcoal which was then sealed inside an iron casing. This recipe was twice as powerful as traditional powder, and provided users with a far deadlier form of ammunition. It was also much less likely to spoil. Congreve's experiments helped Britain become a world leader in the manufacture of gunpowder.

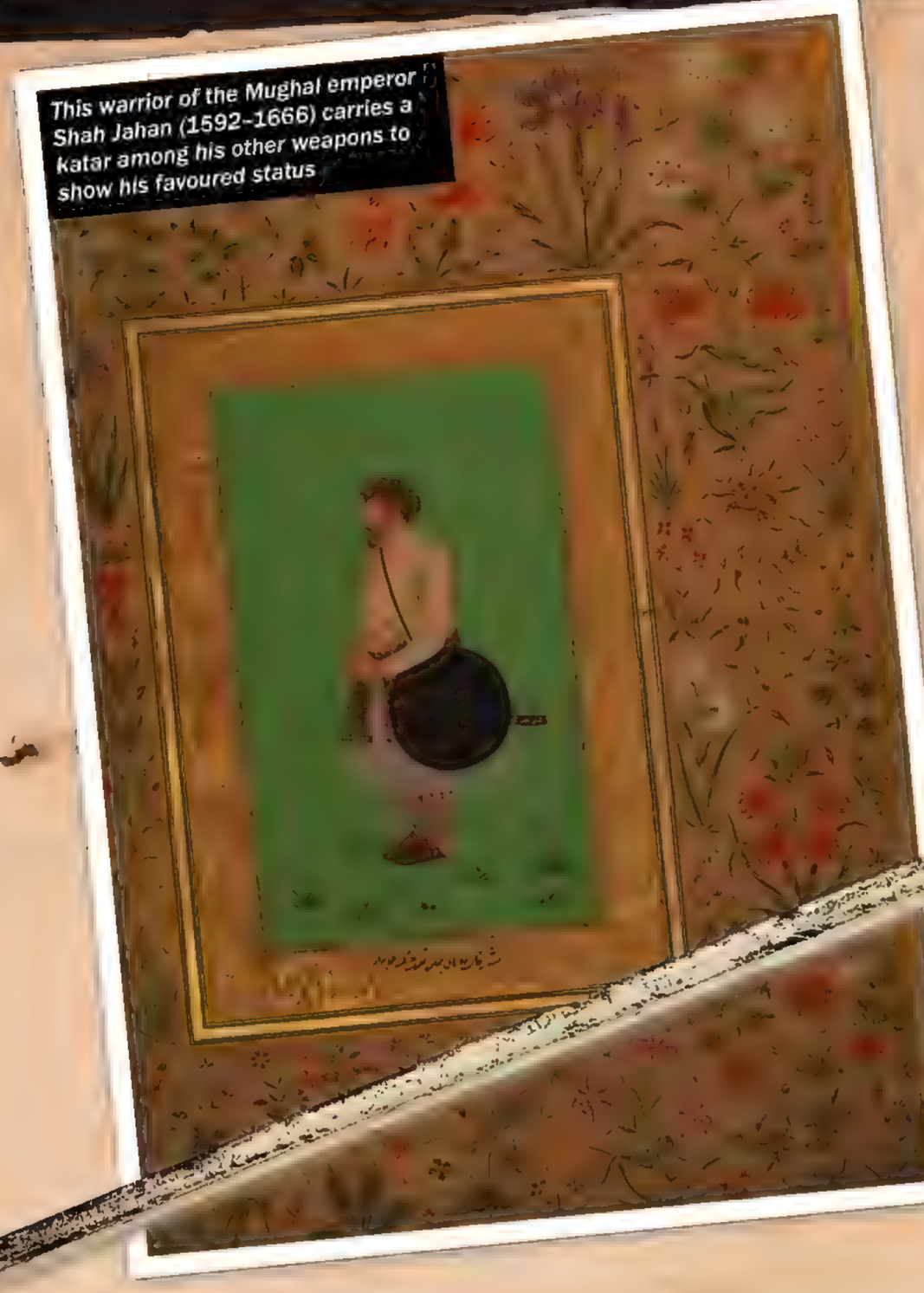


BATTLE OF SVENSKSUND
The Battle of Svensksund, which took place between the naval forces of Sweden and Russia, was the final major naval encounter to predominantly rely on wooden galleys. It was the largest battle to ever take place in the Baltic Sea.
1790

PERCUSSION CAP BECOMES THE NORM
In the early 1830s, a new kind of firing mechanism was produced known as the percussion cap. Used primarily on muzzleloading firearms, it became widely popular because it could be used in most weather conditions, and reduced misfires.
1830

NOBEL INVENTS DYNAMITE
Alfred Nobel, the famous Swedish chemist and inventor, produces a substance incorporating nitroglycerin and clay. Better known as dynamite, this invention proved to be considerably more explosive than gunpowder.
1863

MOVE TO SMOKELESS POWDER
European nations begin to adopt smokeless powder, an improved form of gunpowder. This recipe becomes the default substance referred to as 'gunpowder', while the older version is now known as 'black powder'.
1890



"THE KATAR WAS HELD IN THE FIST AND WIELDED AS IF THROWING A PUNCH, WITH THE FULL WEIGHT OF THE BODY ALLOWING IT TO RUPTURE ARMOUR AND INFLICT HORRIFIC TRAUMA ON THE HEAD OR UPPER BODY. ITS PRIMAL NATURE APPEALED TO THE WARRIORS OF NORTHERN INDIA"

The court of the 17th-century Sultan of Bijapur. The men seated to the right of the picture all wear punch daggers on their belts

INDIAN KATAR

17TH CENTURY

A wicked-looking triangular blade mounted on a frame, the katar – or punch dagger – was a status symbol in early modern Southeast Asia as much as it was a weapon.

Nobles wore increasingly ornate examples on their waists to broadcast their wealth and power, and they continued to be crafted long after their usefulness in battle had declined.

The katar was held in the fist and wielded as if throwing a punch, with the full weight of the body allowing it to rupture armour and inflict horrific trauma on the head or upper body.

The primal nature of the katar appealed to the warrior cultures of northern India, and aristocratic Rajputs and Mughals would boast of hunting tigers with a katar on each fist as the ultimate measure of their valour.

An 18th-century flintlock blunderbuss from the Indian state of Mysore, one of the last holdouts against the encroaching British Empire

FRENCH TRUE FLINTLOCK

17TH CENTURY

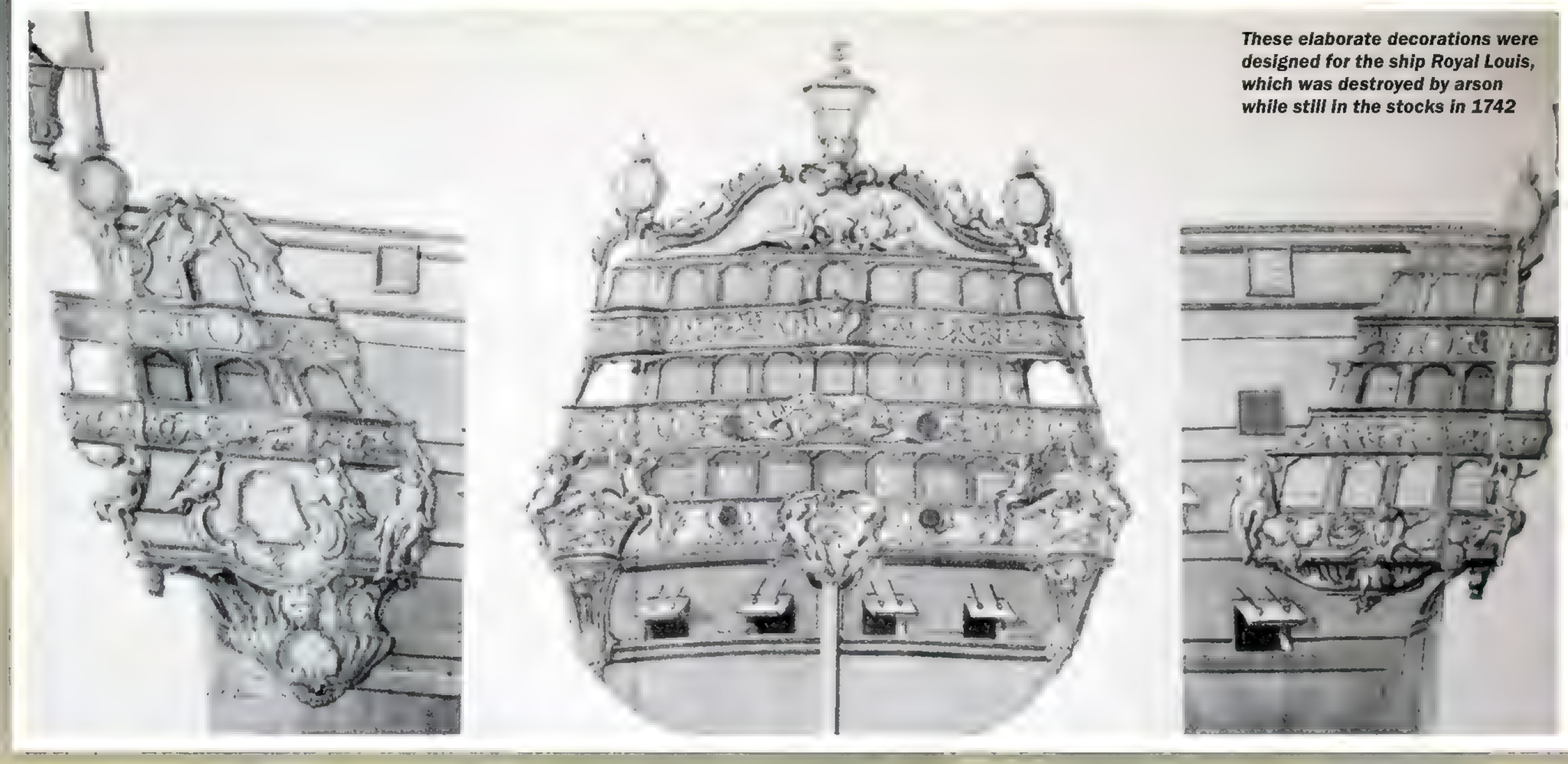
Black powder arms emerged as early as the 13th century and flintlocks from the 16th, but it was only with the advent of the 'true flintlock' mechanism in France in the early 17th century that firearms really arrived on the battlefield.

The mechanism, developed by Marin le Bourgeoys (1550–1634), gunsmith and inventor to Louis XIII, placed a sear between the spring-loaded flint hammer that allowed it to be cocked without firing – effectively providing a safety catch. The striker (which sparked the flint) and pan cover (which shielded the gunpowder) were made in one piece, so that pulling the trigger caused the spring to deploy the hammer and lift the pan cover in one smooth motion.

Le Bourgeoys' true flintlock remained the dominant mechanism for 200 years, eventually being superseded in the 1830s.

"THE MECHANISM PLACED A SEAR BETWEEN THE SPRING-LOADED FLINT HAMMER THAT ALLOWED IT TO BE COCKED WITHOUT FIRING – EFFECTIVELY PROVIDING A SAFETY CATCH "

Men duel with flintlock pistols in this 17th-century satirical etching



These elaborate decorations were designed for the ship Royal Louis, which was destroyed by arson while still in the stocks in 1742

FRENCH SHIP OF THE LINE

18TH CENTURY

For the sea lion's share of maritime history, warships followed the same basic design as their benign counterparts – only the cargo, cannon or trade goods made the difference.

At the beginning of the 17th century naval battles began to change in character. Chaotic squalls became replaced by the 'line of battle' tactic, where tight ranks of ships unleashed artillery broadsides on one another, and close-quarter boarding actions began to fade away, taking the highly fortified superstructures with them.

By the 1740s, the 74-gun French ship of the line became the template from which all other vessels were constructed, beginning with Britain's Royal Navy. Its two-deck design enabled it to bring significant firepower to bear, and unlike three-deck ships it didn't become unstable and unwieldy in rough seas.

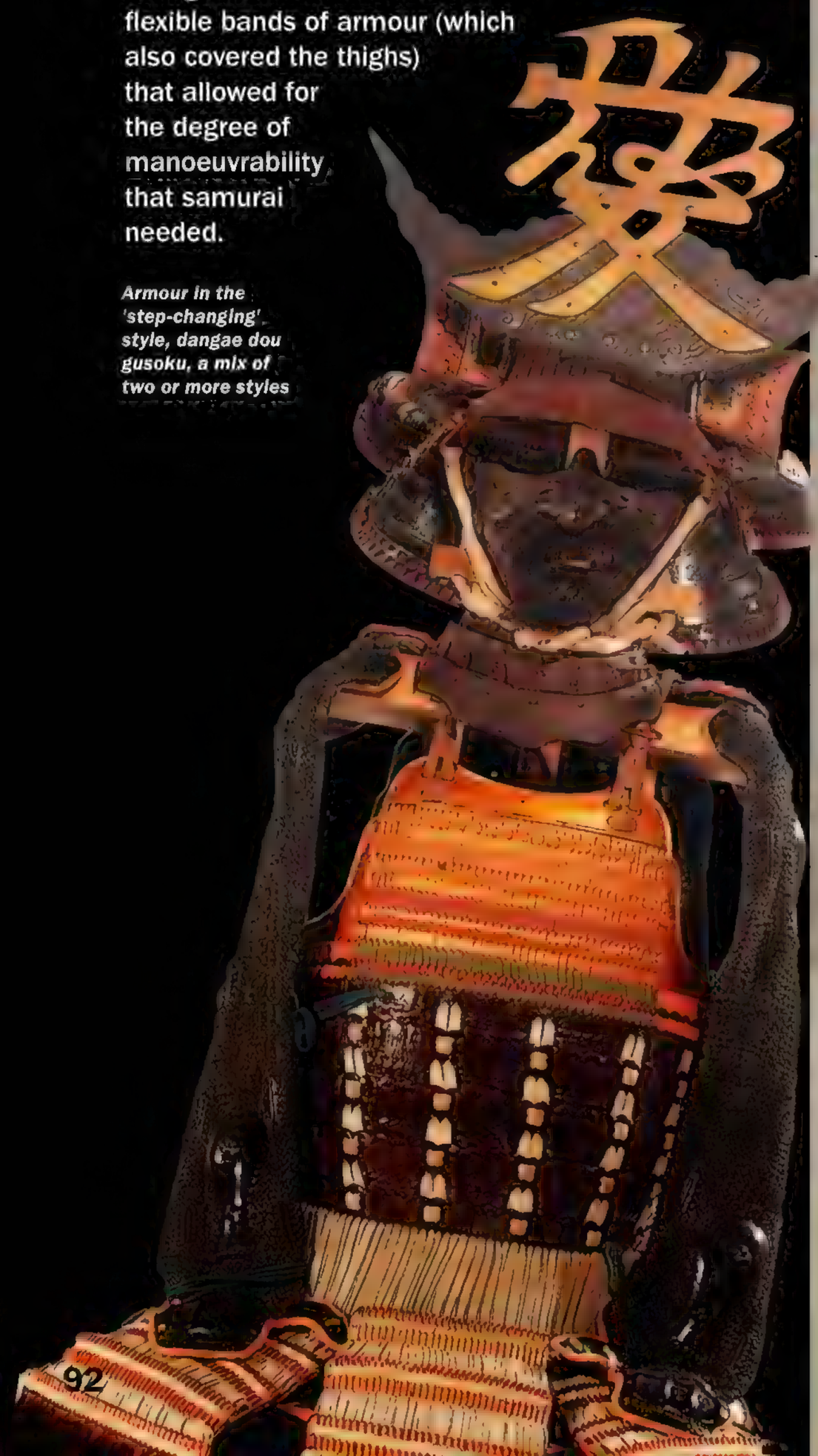
JAPANESE TOSEI GUSOKU

16TH CENTURY

Though the look of samurai armour is seemingly unchanged since the 12th century, the arrival of firearms courtesy of Portuguese merchants in 1543 forced evolution upon them.

Tosei gusoku – meaning 'new armour' – began with samurai incorporating European cuirasses and helmets, which offered greater protection from shot, and soon Japanese armourers introduced homemade solutions.

Helmets were now constructed from large plates of iron and almost fully enclosed face masks, while the torso was protected by either a single iron cuirass or more flexible bands of armour (which also covered the thighs) that allowed for the degree of manoeuvrability that samurai needed.



Armour in the 'step-changing' style, dangae dou gusoku, a mix of two or more styles

Great Battles

ROCROI

WORDS TOM GARNER

FRANCE, 19 MAY 1643

The Spanish tercios fought a desperate last stand against French cavalry and artillery

Spanish and French armies clash in pike and shot formation, in a decisive contest that will change the course of the Thirty Years' War and the balance of power in Europe

The Thirty Years' War was one of the most devastating conflicts in European history, an apocalypse only comparable to the later Napoleonic and world wars. Some parts of what is now Germany lost two-thirds of its population and it is estimated that perhaps 8 million people perished as a direct result of the war, either though military action, violent plundering or outbreaks of diseases that accompanied huge travelling armies. At the heart of this struggle was the fight between France and Spain – the Battle of Rocroi was the climax of this ultimate duel of nations.

Spain had been involved in the war almost from its inception. It was the pre-eminent power on the continent and, in addition to its Iberian heartlands, held vast territories including northern Italy, the Franche-Comté area in what is now eastern France and the Spanish Netherlands in Belgium and Luxembourg. To get to these territories, supplies and soldiers marched along 'The Spanish Road', which snaked north from Italy until it reached the Spanish Netherlands.

The extensive logistics involved were aided by the fact that most of the road passed through territory held by the powerful Habsburg dynasty. In the 17th century, most of Europe was ruled by the Habsburgs, who were divided into two branches. In 1643, one branch was ruled by Ferdinand III, who was the Holy Roman Emperor and ruler of Hungary, Bohemia, Croatia and Austria. The other was led by Philip IV of Spain, who also ruled Portugal and the Spanish Netherlands. His additional titles included the Duchy of Burgundy, sovereign of several Italian states and ruler of a vast colonial empire. Habsburg territory surrounded the land borders of France, making the French extremely nervous about the security of their frontiers. Even at sea they could not feel secure, as Spain was also the dominant naval power, operating separate fleets in the Atlantic and Mediterranean.

Consequently, the French developed a siege mentality and began using diplomatic means to undermine Habsburg supremacy. Cardinal Richelieu, the powerful chief minister of Louis XIII, led these efforts in the early 1630s, and in 1635 he declared war on Spain. At first events did not go well for the French as the Spanish invaded and ravaged northern France. In 1636, even Paris was threatened and French intervention in Italy failed.

At the end of 1642, Richelieu died and was followed to the grave six months later by Louis XIII, who was succeeded by his four-year-old son Louis XIV. With a child on the throne and its most capable minister dead, France was caught in a moment of weakness that Spain saw the opportunity to exploit. Within five days of Louis XIII's death, a large army invaded northern France from the Spanish Netherlands. The board was set for a historic clash of arms.

In May 1643, Spain invaded France with an army of 26,000 men and the intention of marching on Paris. Their plan was to approach from the north east through the Ardennes forest. Blocking their path was the fortress town of Rocroi. Despite being garrisoned by only 4-500 soldiers, Rocroi's location was strategically important. It lay on the border with the Spanish Netherlands and was surrounded by the dense forests of the Ardennes. The town also blocked the main road to Paris and would have to be overcome for a successful march on the capital. Opposing Spain's army was the town's garrison and the Army of Picardy, numbering some 22,000 men. The French were outnumbered; to make things worse, their general was by no means a veteran.

The commanders that faced one another at Rocroi could not have been more different both in character and experience. Aged 46, Spanish General Don Francisco de Melo was an accomplished politician and ambassador who had become the governor of Flanders in 1641. More importantly, he had already won a battle against the French in 1642 at Honnecourt, where the French Army of Champagne had been almost annihilated by a force twice its size.

The battle at Honnecourt had left northern France exposed to the Spanish army,

"WITH A CHILD ON THE THRONE AND ITS MOST CAPABLE MINISTER DEAD, FRANCE WAS CAUGHT IN A MOMENT OF WEAKNESS THAT SPAIN SAW THE OPPORTUNITY TO EXPLOIT"

however, de Melo cautiously chose not to exploit this victory in 1642. He believed he could successfully consolidate his triumph in preparation for the following campaign, when he would have more fresh troops. In 1643, de Melo would have been more than confident of his chances of success.

Facing de Melo was Louis de Bourbon, Duc d'Enghien. At the alarmingly young age of 21, Enghien was a senior member of the French royal family but an untried general. He was a member of the Condé branch of the House of Bourbon and cousin to Louis XIII and XIV. As befitting his high rank, Enghien had received a thorough education, but his experience of military affairs was quite limited. Before 1643, he had only seen action at the sieges of Arras and Perpignan, neither of which he had been in command for. Rocroi would not just be his first battle, but also his first command as a general. It was a tough assignment, as he would be facing the finest fighting force of the previous 100 years.

Having approached Rocroi, de Melo immediately surrounded the fortress – he did not want the town to remain un-captured in his rear while he continued to Paris. While this was happening, couriers were hurriedly sent to Enghien's nearby army. The French general rapidly marched to relieve Rocroi and fend off the Spanish, but while he was moving, he received word there were 6,000 Spanish reinforcements marching to Rocroi to supplement de Melo's numbers. The situation, already dangerous, was now turning critical. Enghien knew he had to defeat de Melo before the reinforcements could tip the balance.

To approach Rocroi, there was only one access road, and it ran through a deep defile in a ridge south of the town. Luckily for the French, the road was unguarded and Enghien safely passed through, drawing up his army on a ridge facing the rear of the Spanish force. Not guarding this southern road to Rocroi was a mistake the Spanish would come to regret.

The area immediately around Rocroi was a small clearing in the Ardennes forest. When de Melo saw the French deploying behind him, he reordered his forces on a facing ridge next to the fortress, with a stream in marshland positioned between the two armies. Night was falling, but nonetheless a French cavalry unit attempted to relieve the town. This failed and the cavalry were repulsed. Both armies now slept in their positions, preparing for the start of the battle to come.

Before dawn on 19 May, the two armies lined up in very similar positions to the previous day. Both sides placed their cavalry on the flanks and the infantry, which was arranged in two lines, was placed in the centre. Finally, each army's artillery was drawn up in front of the infantry. There were also reserves: the French could call upon two squadrons of cavalry, three

The Duc d'Enghien orders his troops to stop fighting as the Spanish offer surrender

Above: The tercios were the elite units of the Spanish infantry and were famed throughout Europe for their fighting prowess

Right: Pikemen were an essential component of the Spanish tercio. This particular soldier is holding a halberd

© Jose Cabrera

THE TERCIOS

HOW THESE MULTI-ROLE UNITS CAME TO DOMINATE EARLY MODERN BATTLEFIELDS

For decades Spain's tercios were the most fearsome, elite military unit in Early Modern Europe. The tercio had developed out of a combination of improvements in gunpowder technology and the rise of the infantry square during the 15th century. Swiss pikemen had become famous for forming highly disciplined squares and successfully defeating heavy cavalry charges led by the Duke of Burgundy. The Spanish, learning from their own military campaigns in Italy, took this method one step further by deploying firepower units, such as the arquebus, in between the pikemen. This dramatically increased the strength and flexibility of the square. There was an equal distribution of pikemen and gunmen and they fought together in the same tactical formation under strict discipline.

Each tercio numbered 3,000 men and was formed of 12 companies of 250 men – the same size as a modern brigade. Within each company the pikemen formed a central block ten ranks deep, while an equal number of arquebusiers operated on the flanks. The pikemen needed depth to form a solid formation that could resist cavalry attacks – this became commonly known as the 'push of pike'. At the same time, the arquebusiers were deployed in equal depth in order to maximise firepower. The volleys of gunfire were controlled with great discipline and efficiency, as arquebusiers were formed up in two lines and trained not to fire without orders. The practice was for the front rank to deliver a single mass volley, then retire to the rear of the square to reload. The second rank would then step forward, aim, fire on order and also retire so that the front rank could fire again. These tactics meant that a Spanish tercio could deliver continuous volleys against an advancing formation. To maintain the high quality of a tercio's performance, care was taken to keep a high number of veterans in the units to encourage the younger soldiers. This professionalism made the tercios the best infantry in Europe and they gained a reputation for invincibility in major battles – it was a reputation that would be ultimately tested at Rocroi.

battalions of infantry and six companies of gendarmes. The latter was a relatively new type of unit that consisted of lightly armoured troops armed with pistols and swords. The Spanish had two squadrons of cavalry in reserve in addition to the 6,000 reinforcements that were on their way.

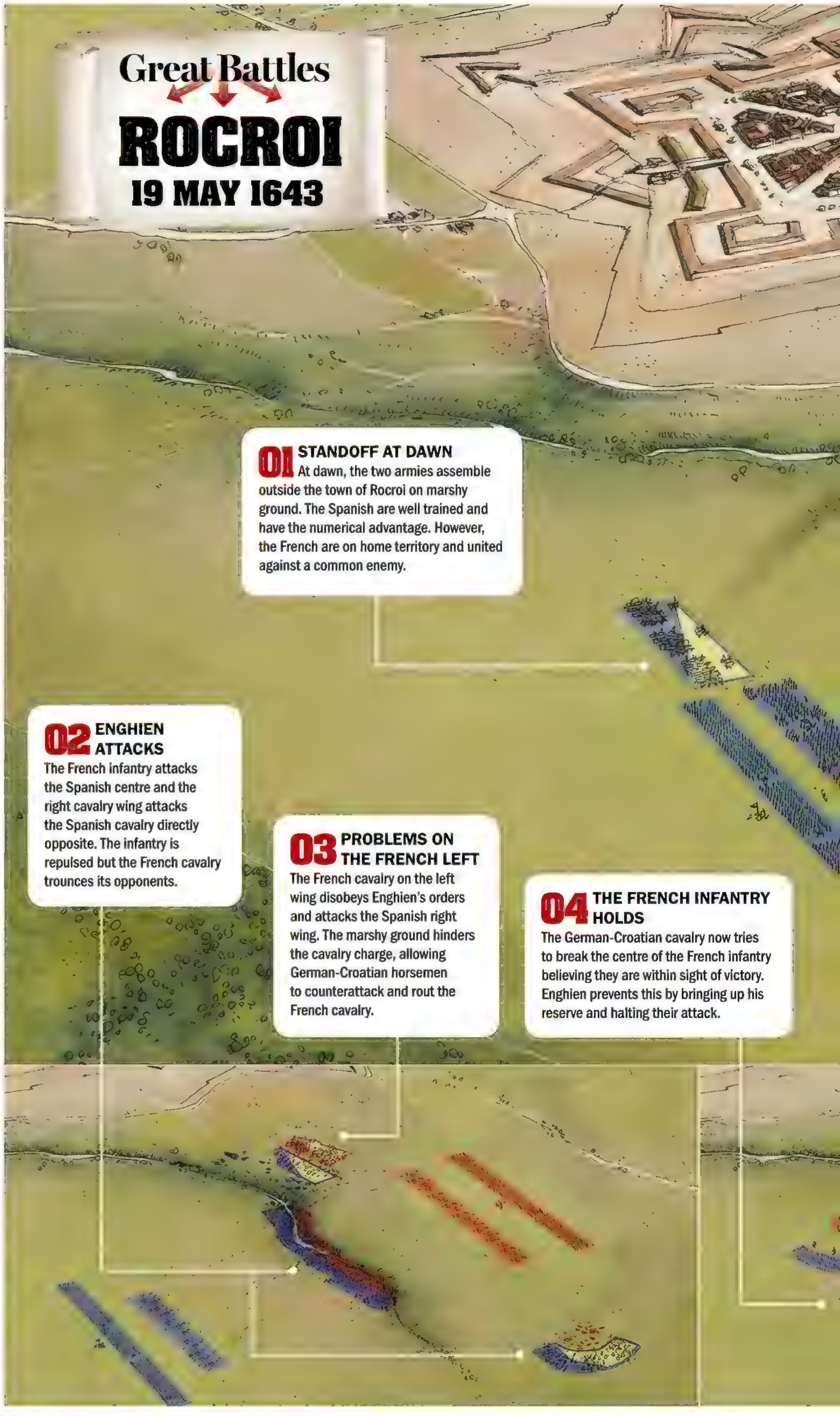
In this sense, the two armies appeared almost identical, both in the deployment of their positions and the numbers of frontline soldiers and reserves involved. Enghien and de Melo were even stationed in their respective right cavalry wings, creating a strange sense of military symmetry. However, one of the unlikely differences between the two armies was loyalty.

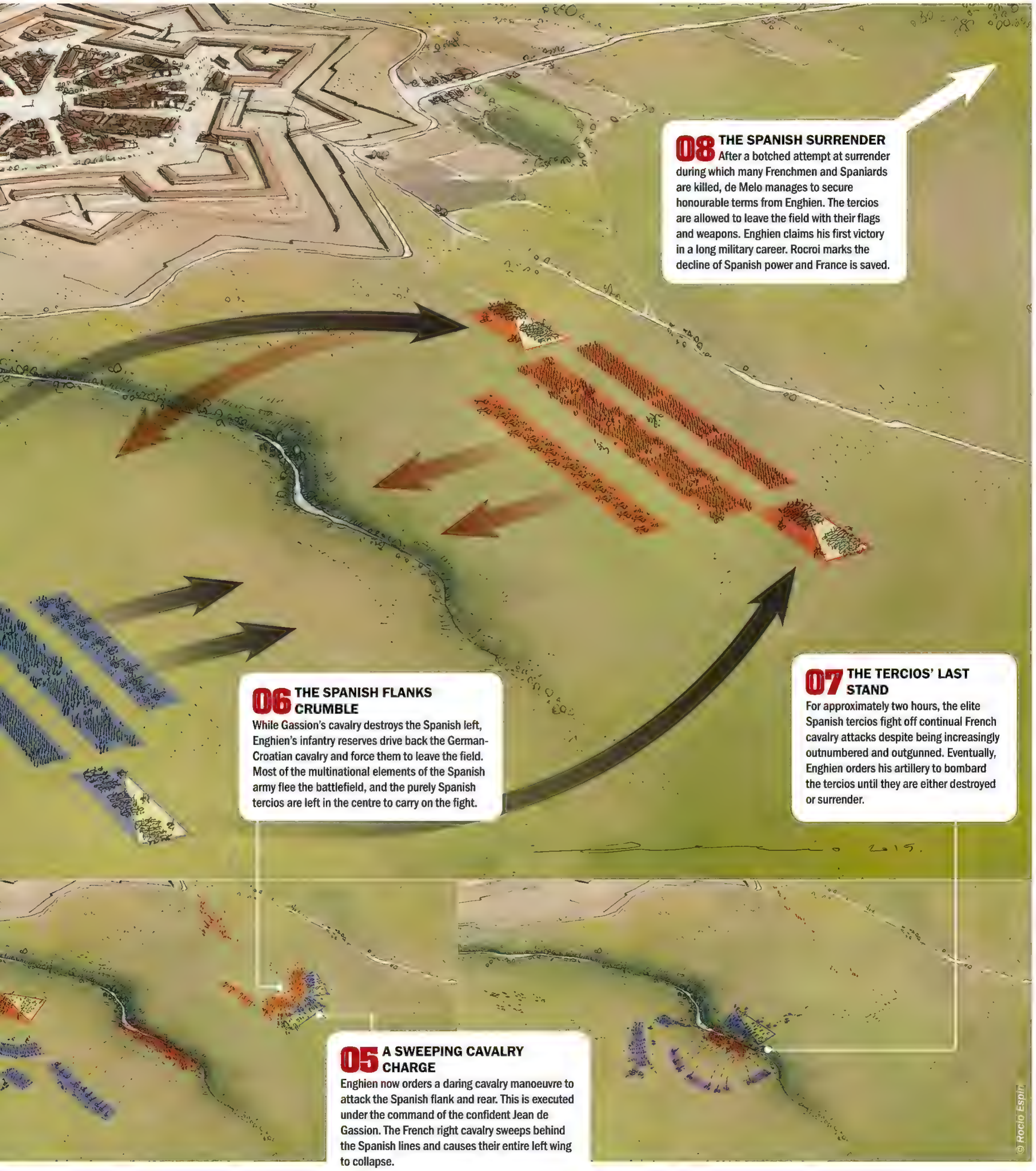
The French army, with the exception of some Swiss, Scottish and Hungarian troops, was almost entirely French in its composition. On the other hand, the 'Spanish' army was a melting pot of different nationalities drawn from many different parts of Europe. It would perhaps be more accurate to call de Melo's force an 'Imperialist-Habsburg' army, as the troops all came from lands controlled by Habsburgs, but swore different allegiances, either to Philip IV or the Holy Roman Emperor.

For example, the front line of infantry consisted of five purely Spanish tercios, but five more came from Italy and Franché-Comte. The second line of infantry comprised nine battalions of German, Italian and Walloon troops. The cavalry was equally diverse, as the left wing numbered 15 squadrons of Flemish cavalry while the right had 14 squadrons of German and Croatian horsemen. This diversity of allegiances, under the umbrella of Habsburg authority, would have a decisive effect on the course of the battle. The Spanish may have been exceptionally well trained, but their lack of national cohesiveness meant that units were not fully inclined to support one another in a

***Below:** Along with pikemen, halberdiers were a small but essential part of the Spanish tercio*

© Jose Cabrera





08 THE SPANISH SURRENDER
After a botched attempt at surrender during which many Frenchmen and Spaniards are killed, de Melo manages to secure honourable terms from Enghien. The tercios are allowed to leave the field with their flags and weapons. Enghien claims his first victory in a long military career. Rocroi marks the decline of Spanish power and France is saved.

07 THE TERCIOS' LAST STAND
For approximately two hours, the elite Spanish tercios fight off continual French cavalry attacks despite being increasingly outnumbered and outgunned. Eventually, Enghien orders his artillery to bombard the tercios until they are either destroyed or surrender.

06 THE SPANISH FLANKS CRUMBLE
While Gassion's cavalry destroys the Spanish left, Enghien's infantry reserves drive back the German-Croatian cavalry and force them to leave the field. Most of the multinational elements of the Spanish army flee the battlefield, and the purely Spanish tercios are left in the centre to carry on the fight.

05 A SWEEPING CAVALRY CHARGE
Enghien now orders a daring cavalry manoeuvre to attack the Spanish flank and rear. This is executed under the command of the confident Jean de Gassion. The French right cavalry sweeps behind the Spanish lines and causes their entire left wing to collapse.

© Rocio Espin

Above: This matchlock musket was a typical weapon used by arquebusiers in the 1640s

"THE FRENCH CAVALRY SWEPT AROUND THE REAR OF THE SPANISH IN A GREAT THUNDER OF HORSESHOES AND HUMAN CRIES. ENGHIEN'S PLAN WORKED BRILLIANTLY"

common cause. To assert Spanish authority, de Melo ensured that Spaniards commanded the majority of his wings and brigades and the core of the infantry centre was filled with the veteran Spanish tercios. The French, on the other hand, were fighting on home territory and were filled with a proud sense of national defiance against a belligerent invader.

At dawn, Enghien opened the battle with an infantry assault on the Spanish centre while the right cavalry wing attacked the opposing Spanish cavalry. The infantry attack failed but the French cavalry managed to rout its Flemish opponent, exposing the Spanish centre to the French. Despite this initial setback, the Spanish centre held its position. Buoyed by the success of its right wing, the French left cavalry disobeyed Enghien's orders and attacked the Spanish right wing in true cavalier style. However, the ground in front of the cavalry was marshy and the horses became bogged down in the muddy ground. The German and Croatian cavalry observed this foolhardy bravado and immediately counter-attacked, driving the stricken French left cavalry from the field. The cavalier attitude of the French horse nearly cost Enghien the battle after only an hour of fighting. The German-Croats attempted to follow up their success by moving to attack the left infantry flank of the French centre – if this succeeded, de Melo's army could have secured a quick victory. However, Enghien moved his reserves up from the rear and blocked the charge of the German-Croats.

Having saved his infantry, Enghien decided to seize the initiative by launching his entire right wing in a great cavalry charge to strike the flank and rear of the Spanish infantry. It was a daring manoeuvre that required great skill in order to execute, as there was a high chance that the French infantry could be exposed. However, Enghien was lucky in that he had a great cavalry captain commanding the right wing: Jean, comte de Gassion. He had extensive experience fighting for King Gustavus Adolphus of Sweden and such was his reputation that Cardinal Richelieu had nicknamed him 'La Guerre' (War). Gassion was a safe pair of hands with which to trust this dangerous gamble.

It would have been a magnificent and frightening sight. The French cavalry swept around the rear of the Spanish in a great thunder of horseshoes and human cries. Enghien's plan worked brilliantly. Faced with this surprise cavalry onslaught, the German, Italian and Walloon infantry completely collapsed and were routed from the field. At the same time, the French infantry reserves broke the German-Croats assaulting the French left and chased them down.

It was now just 8am, and the French cavalry charge, along with the renewed spirit of the infantry, repulsed and routed many of the enemy units. However, this was where the polyglot nature of Spain's army caused problems not just for the Spanish themselves but for the French too. The units that fled and retreated in the wake of the French onslaught had been the Germans, Italians, Walloons and Croats. None of them had

The French and Spanish arranged their armies in almost identical formations on marshy ground near Rocroi

felt a genuine concern to stand by their Spanish comrades and had chosen flight over military cohesion. De Melo's army was now reduced to the purely Spanish tercios, who stood firm as a rock in the centre of the line. They would be very difficult for the French to break, as Enghien was about to discover.

The French general reformed his cavalry and ordered them to directly attack the tercios, despite the fact that both men and horses were tired from charging already. The fatigued French twice attacked the squares but both assaults achieved nothing but bloodshed. The tercios, true to their reputation, remained immovable. Enghien did not want to waste attacks and potentially lose the battle to the stubbornness of the tercios, and he became determined to break them. In a rather un-chivalrous move, he ordered his artillery, along with some captured Spanish cannon, to come up and directly open fire on the obstinate squares. At the same time, he ordered more cavalry charges.

The tercios held firm despite the continual bombardment and cavalry charges. Eventually, though, the superiority in numbers and onslaughts began to tell on the Spaniards, and they became surrounded and outnumbered with increasing casualties. For the tercios, the Battle of Rocroi was turning into a desperate last stand with smoke, fire, noise and death all around them.

As the battle was drawing to a close, some surviving Spanish officers tried to surrender.

"THE FATIGUED FRENCH TWICE ATTACKED THE SQUARES, BUT BOTH ASSAULTS ACHIEVED NOTHING BUT BLOODSHED"

According to some sources, when the French came forward to accept their surrender, a group of Spanish soldiers opened fire at the approaching soldiers. The reasons for this are uncertain – either the soldiers did not hear the word to surrender or refused to do so. In any case, this action infuriated the French and they resumed their assault, inflicting many more casualties. Finally, the remnants of the Spanish artillery and arquebuses fell silent, having run out of ammunition. It would have been a dire atmosphere of blood and sweat with the cries of the wounded, desperate and dying, to be heard all around.

De Melo, whose exact whereabouts at this stage are disputed, decided to surrender so that his remaining troops would not be destroyed. Although it was obvious that he was defeated, de Melo requested that the French offer the same terms of surrender that were generally made to the defenders of a fortress. This request would mean that the Spanish could leave the field with their colours and retain their weapons. This was a rather presumptuous and tenuous demand for de Melo to make for two reasons: first, as the commander of the defeated army he was in no position to bargain with Enghien. Second, the Spanish had not fought inside the walls of Rocroi but just outside, and so had been fighting in open battle and were technically not eligible for these terms. However, Enghien granted this request in a spirit of generosity and perhaps in a respectful gesture to the bravery of the tercios. The exhausted Spanish left the field defeated, but with their honour intact. When the fighting stopped, the time was about 10am. Although the substantial Spanish reinforcement of 6,000 men had appeared near to the battlefield, they wisely stayed away as they could see that the battle was lost. Rocroi had been a bloody encounter with significant casualties. The Spanish lost 7-8,000 men dead or wounded with another 7,000 taken prisoner, while the French lost about 4,000 troops or more.

Though the clash did not end the Thirty Years' War, in the short term France was saved from invasion. For the French, it was a highly symbolic victory as it was one of the few major battlefield defeats of a Spanish army in more than a century. The defeat of the tercios in particular was regarded as a great triumph – the Spanish could never replace their elite infantry, and after Rocroi, Spain became a declining power for the rest of the war. It was now the French who would dominate European affairs.

Images: Alamy, Jose Cabrera, Corbis, Mary Evans

THE WAR RAGES ON

Prior to Naseby, the war between the Royalists and the Parliamentarians had been raging for three years. With neither side ever quite taking complete control of the conflict, there needed to be an encounter that decided the war before both sides ran out of steam. Naseby would be that battle.

GET IN LINE!

Both sides took different approaches to battle formations. The Royal Army incorporated three lines of musketeers in the centre with cavalry on the flanks. The Parliamentarians had two lines rather than three with musketeers out at the front.

CAVALIERS

Lacking the discipline of their adversaries, the Royalist cavalry often attacked individual targets rather than staying in rank. Although they were fighting a Parliamentarian army, about half of the MPs fought for the king. In contrast to the Roundheads, they would often wear fancy clothes with long hair and beards.

LOBSTER POTS

Nicknamed 'lobster pots' or 'ironsides', the soldiers of the New Model Army were recognisable due to their metal helmets. They would traditionally cut their hair very short and wear plain clothes as well as a cuirass breastplate.

FAIRFAX'S TACTICS

The New Model Army based its strategy around its lightly armed cavalry. Their attacks were built on speed and surprise and would aim for the flanks to avoid and outmanoeuvre the strong centre of the Royal Army.

THE BATTLE OF NASEBY

Cavaliers and Roundheads clash with sabres and matchlocks in a key battle of the English Civil War

VILLAGE OF NASEBY, NORTHAMPTONSHIRE
SATURDAY 14 JUNE 1645

Naseby may only be a tiny English village in the Midlands, but on the morning of 14 June, it played host to a pivotal battle in the English Civil War. The bloody nationwide conflict had been drawn out for more than three years, with neither side managing to assert any clear authority. The Parliamentarian forces were now more determined than ever to finally bring down the Royalist cause, and on this day, the New Model Army, a modernised professional fighting force, would prove its supremacy.

The Roundheads' influential leader, Oliver Cromwell, was present but would not be leading his forces, so the task fell to the talented commander Thomas Fairfax. The Royalist army would be led by the king, Charles I, and supported by his loyal band of subjects.

As the clock ticked past 9am, battle began on the misty open fields of Northamptonshire. Overlooking the village from a ridge, the 12 regiments of the New Model Army made the first move and marched into Naseby. The opposing armies now lined up face to face, with the cavalry regiments on the flanks and the infantry occupying the centre ground. The Royalists had a German commander in their ranks, and it was Prince Rupert of the Rhine who began proceedings with a rapid cavalry charge through the fog after he spotted enemy dragoon movement on the battlefield's western edge. The charge crashed into the Roundhead ranks, sweeping aside the stunned Parliamentarian horsemen, but instead of attacking the now exposed infantry, they pressed on to assault a baggage wagon in the centre of Naseby. Next came Charles's infantry and remaining mounted units, who engaged in a full frontal assault on the reeling Parliamentarians. The sheer ferocity of the attack drove the Roundheads back but could not maintain its momentum, and the Royalists failed to strike a crippling blow as the Parliamentarians slowly but surely began to regroup.

Rupert's decision to concentrate on the baggage train was a timely reprieve for Fairfax, who responded by directing his mounted troops, led by Cromwell, to attack the opposing flank. This attack became a key part of the battle. Sir Marmaduke Langdale's Royalist troops wilted in the face of the rapid cavalry attack and the Royalist infantry were sucked into a perfectly executed pincer movement before completely breaking. If Langdale's flank had held out, the Royalists could have potentially recovered, but it wasn't to be. Charles and his forces were now wide open to attack left, right and centre. Surrender was not far away.

Prince Rupert returned from the baggage train soon after but was now too late to bail out his allies. As the dust settled, it became clear that the Royalists had lost the battle and more than 1,000 men had died in only three hours of fighting. In contrast, the ruthless New Model Army only recorded casualties of about 200 men. Many of the king's best officers lay dead and his artillery abandoned as the remaining Royalists fled the scene. The battle was a hammer blow to the king, and within a year, the final pockets of royal resistance were taken care of. Cromwell was now the undisputed leader of his country and the age of the Lord Protectors was begun.

THE ROYAL ARMY

INFANTRY 6,000

CAVALRY 5,500

KING CHARLES I

LEADER

Dismissive of Parliament's role in governing the country, Charles preferred absolute rule, which led to tension and eventually civil war.

Strengths Unshakable belief in his God-given right to rule.

Weakness Declining support base due to his actions while in power.

CAVALIER

KEY UNIT

The iconic mounted units were key to Charles's military strength.

Strengths Experience of a long and hard civil war.

Weakness Position was based on status, not fighting ability.

MATCHLOCK

KEY WEAPON

A type of musket, it was wielded by both the cavalry and infantry.

Strengths Power and range of shot.

Weakness Slow reload time and poor aim.

01 THE ROAD TO NASEBY

June 1645 and the civil war is reaching fever pitch. King Charles is persuaded to march from his stronghold in Oxford to relieve Chester, which is being besieged by Parliamentarian forces. Away from the siege, the main crux of Oliver Cromwell's New Model Army is assembling and evading any confrontation as it moves north. This delay allows it to reach maximum strength on the road to Naseby.

02 LEAVING THE RIDGE

Fresh from sacking Leicester, the king's men arrive atop a ridge but soon make their descent to the battlefield. Cromwell and Fairfax meanwhile move their dismounted dragoons (musket-armed horsemen) along the Sulby Hedge, positioning them to fire into the Royalist flanks. The small skirmish works as Prince Rupert gives up his superior position on the high ground to charge at the New Model Army. The battle has begun.

03 INITIAL ROYALIST SUCCESS

Rupert's cavalry attacks with intense ferocity and the Parliamentarian line buckles under the pressure. Instead of turning in to harass the infantry, they decide to focus on the Parliamentarian baggage train.

04 FAIRFAX'S MASTER PLAN

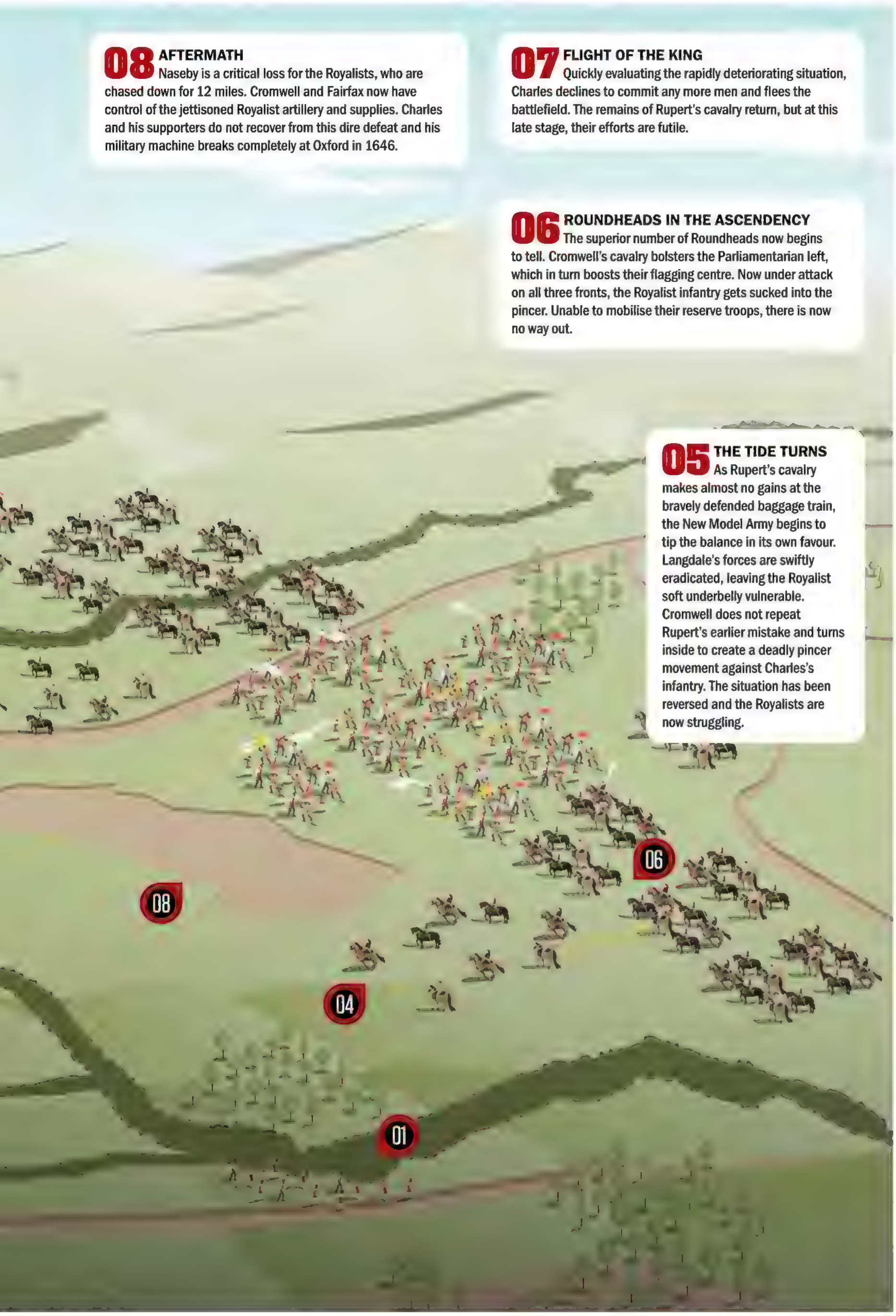
By 11am, the Royalist infantry has engaged the Parliamentarians and is also enjoying some early successes. However, with a significant amount of the Royalist mounted troops now occupied with the baggage train, Fairfax seizes the initiative. Cromwell, who is marshalling the left flank, moves against the right side of the Royalist ranks, which are led by Langdale. The Ironside left wing is unleashed to devastating effect.

08 AFTERMATH
Naseby is a critical loss for the Royalists, who are chased down for 12 miles. Cromwell and Fairfax now have control of the jettisoned Royalist artillery and supplies. Charles and his supporters do not recover from this dire defeat and his military machine breaks completely at Oxford in 1646.

07 FLIGHT OF THE KING
Quickly evaluating the rapidly deteriorating situation, Charles declines to commit any more men and flees the battlefield. The remains of Rupert's cavalry return, but at this late stage, their efforts are futile.

06 ROUNDHEADS IN THE ASCENDENCY
The superior number of Roundheads now begins to tell. Cromwell's cavalry bolsters the Parliamentarian left, which in turn boosts their flagging centre. Now under attack on all three fronts, the Royalist infantry gets sucked into the pincer. Unable to mobilise their reserve troops, there is now no way out.

05 THE TIDE TURNS
As Rupert's cavalry makes almost no gains at the bravely defended baggage train, the New Model Army begins to tip the balance in its own favour. Langdale's forces are swiftly eradicated, leaving the Royalist soft underbelly vulnerable. Cromwell does not repeat Rupert's earlier mistake and turns inside to create a deadly pincer movement against Charles's infantry. The situation has been reversed and the Royalists are now struggling.



NEW MODEL ARMY

INFANTRY 7,000

CAVALRY 8,000

SIR THOMAS FAIRFAX

LEADER

Appointed captain general of the New Model Army in 1645, Fairfax ranked above Cromwell due to the rule of Self-denying Ordinance.
Strengths Long career in the Parliamentarian Northern Army.
Weakness Naseby would be his first major engagement as captain general.

ROUNDHEAD DRAGOON

KEY UNIT

Led by Colonel John Okey, the dragoon units numbered at more than 1,000 strong.
Strengths Armour could deflect pistol fire and sword strokes.
Weakness Vulnerable to mounted cavalier attacks.

SABRE

KEY WEAPON

Firearms were often slow and inaccurate so cold steel still had a big part to play in the battles of the civil war.
Strengths Unmatched weapon at close quarters.
Weakness No defence against ranged attacks.

© Edward Crooks, Alamy

ICON OF WAR: CAVALRY SABRE

Wielded from horseback, a slice of cold curved steel was a devastating weapon on the 19th century Napoleonic battlefield

The first sabre-like swords or scimitars were brought over to Europe in the 18th Century, having been copied by the imperial powers from Asian mamelukes. There were both light and heavy versions and the latter's 36-inch blade could slice limbs in a single blow.

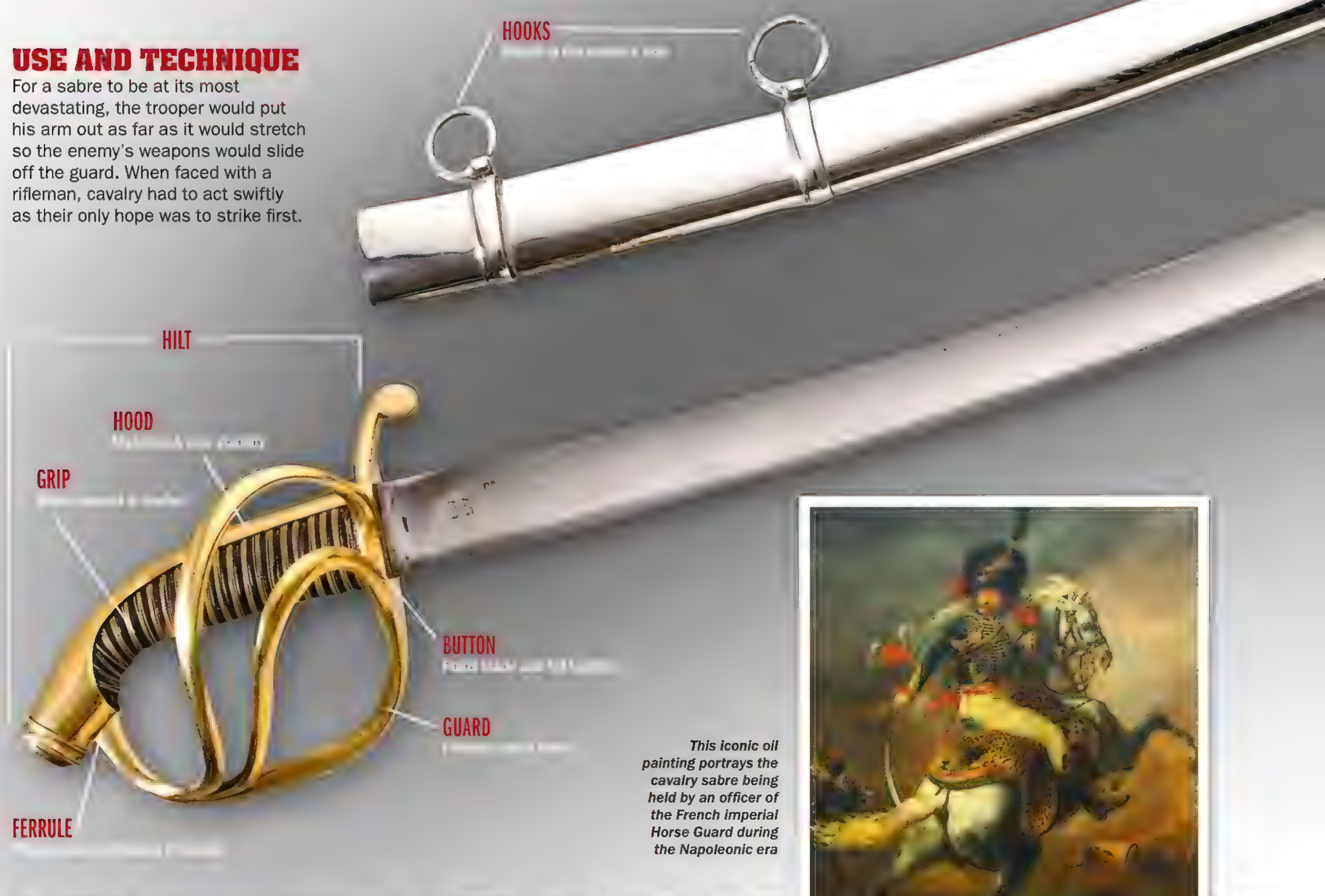
They were made from 1055 carbon steel, which is tough and durable. After the Americans used these sabres to great effect in the American War of Independence, the British decided to design their own: the 1796 light cavalry sabre.

Extremely effective in the Napoleonic Wars, the lightweight, curved blade enabled a quick slicing action when delivered from horseback. It was so well received that the Prussian government ordered 6,000 of them and updated the sword. With its extended blade and focus on slashing rather than thrusting, it increased the value of cavalry on the battlefield as they were slowly phased out.

"THERE WERE BOTH LIGHT AND HEAVY VERSIONS OF THE SABRE, AND THE LATTER'S 36-INCH BLADE COULD SLICE LIMBS IN A SINGLE BLOW"

USE AND TECHNIQUE

For a sabre to be at its most devastating, the trooper would put his arm out as far as it would stretch so the enemy's weapons would slide off the guard. When faced with a rifleman, cavalry had to act swiftly as their only hope was to strike first.



This iconic oil painting portrays the cavalry sabre being held by an officer of the French imperial Horse Guard during the Napoleonic era

In their prime, heavy cavalry could have a devastating effect on infantry

LANCERS, HUSSARS AND DRAGOONS

There were various types of cavalry in the 18th and 19th Centuries, which all had different roles on the battlefield. Hussars and lancers were light cavalry, dragoons medium and cuirassiers were heavy. The lighter units were useful for scouting and engaging infantry while the heavier divisions broke enemy lines and were the ultimate shock troops of the age.

A model 1809 cavalry sabre

SCABBARD
Protects the blade when not in use

BLADE
Designed for slashing not thrusting

SABRE DESIGN

The hilt of a cavalry sabre could come in all shapes and sizes depending on which army you served, which regiment you were in and how sizeable your wallet was. Some had extravagant decorations adorning the handle that also helped protect the soldier's hand and increased the grip. The blade could also be decorated with insignias engraved into the edge. A weapon of high quality throughout the 18th Century, the cavalry sabre belonged to grenadiers and cavalry units on all sides during the Napoleonic Wars. As well as being effective in battle, they had status as a ceremonial weapon and are still used in parades and formal processions to this day.

Sporting a grand hilt, this sabre was wielded by Michel Ordener, a commander in Napoleon's imperial Guard

This is an example of a standard sabre used by an officer in the French Hussars regiment during the Napoleonic Wars

This highly decorated sabre belonged to a senior officer in the Hussars of the First French Empire

ICON OF WAR
CUIRASSIER ARMOUR

As the growing use of firearms changed the shape of European warfare, cavalry needed to adapt their armour accordingly

HELMET
The plate crowning the forehead horizontally was intended to stop the downward swing of a blade, which otherwise might have dealt a fatal blow. These kinds of fully enclosed helms, known as a close helmets, became less popular in time, as they were deemed too impractical.

HEAVY CAVALRY
Emerging during the early 17th Century, this armour was developed in response to the increased use of firearms on battlefields. Much more flexible than earlier medieval suits of armour, the cuirassier's armour plate was thicker and several layers were combined to provide extra protection. When a suit of this armour was completed, it would be shot at with a musket to test its effectiveness at stopping projectiles. These 'proving marks' were evidence that the armour would do its job on the battlefield.

DETAILS

YEAR c. 1600
WEIGHT 30-40kg
MATERIAL Steel, leather, mail.
ORIGIN Europe (Savoyard style)

THREE-QUARTER LENGTH
Greater emphasis was placed on protecting the torso and upper legs of the cavalryman. This meant the armour was constructed and shaped with a mind to the wearer constantly being sat in a saddle. Cuirassier-style half-suits were also developed for infantrymen, but didn't feature such extended leg protection.

TORSO PROTECTOR

Cuirassiers derived their name from the cuirass, or breastplate. By the end of the 18th and into the 19th Century cuirassiers wore only the cuirass and helmet, protecting the most vital areas of the body.

SABRE STRIKE

Without the extra weight of limb extensions to their armour, it was easier for cuirassiers to swing their sabres down on the enemy. By the 19th Century the sword had become the cuirassier's primary weapon over the lance or pistol, which were still used, but less often.

CEREMONIAL

A far cry from their brutally functional 17th Century origins, cuirassier helms eventually took on more fashionable and flamboyant designs. The units truly came into their own during the Napoleonic Wars, where each country's mounted units were instantly recognisable from their unique appearance.

Cuirassier armour can still be seen worn in the ceremonial and parade uniforms of many mounted units, such as the UK's Household Cavalry

© INTERFOTO / Alamy

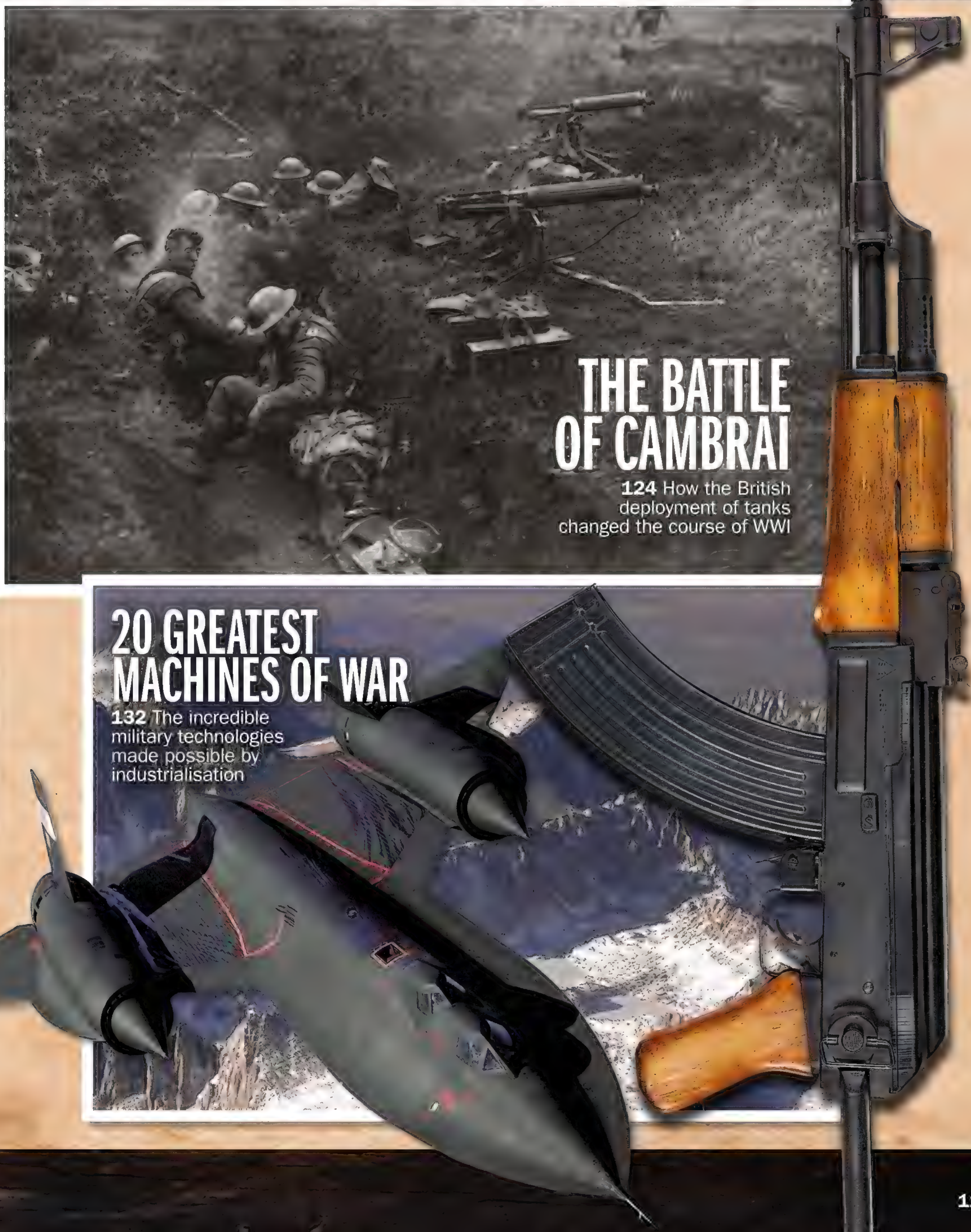
INDUSTRIAL WARFARE

WARFARE IN THE INDUSTRIAL WORLD

112 Advancing technology has magnified the scale of warfare, fostering the development of total war and the military-industrial complex

WEAPONS OF WAR

116 Weapons change radically in the age of mass production



THE BATTLE OF CAMBRAI

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20 GREATEST MACHINES OF WAR

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WARFARE IN THE INDUSTRIAL WORLD

Advancing technology magnified the scale of warfare in the modern age, and fostered the development of total war and the military-industrial complex

WORDS MIKE HASKEW

Warfare in the mid-19th century ushered in an era of refinement in the art and science of killing. Technology with both civil and military applications continued to advance at an astonishing pace, and leveraged more fully the inventions and discoveries of earlier times such as gunpowder, interchangeable parts, the steam engine and the efficiencies of the Industrial Revolution.

Many historians consider the Crimean War of 1853-56 to be the first truly modern war, particularly by virtue of its technological advances in military hardware. The conflict served as a proving ground for the railway, which brought mass transportation of men and guns to the battlefield. It also introduced iron warships, heavy calibre artillery, and a previously unknown lethality for the shoulder arm carried by the individual soldier. In 1849, French Army Captain Claude-Étienne Minié invented a new bullet that bore his name. The innovative bullet featured a conical shape with grooves that conformed to rifling in the weapon's barrel, causing the projectile to spin as it left the muzzle, resulting in a longer range and greater accuracy than ball ammunition from a smoothbore musket.

The American Civil War furthered the example of the Minié ball with devastating results, and the invention of the repeating rifle brought death on an unprecedented scale among foot soldiers. The Spencer repeater, soldiers said, could be "loaded on Sunday and fired all week." By the turn of the 20th century, shoulder arms were even more efficient, as highly accurate bolt-action rifles, developed in Britain, Germany and elsewhere, came into common usage. British inventor Hiram Maxim patented a machine gun in 1895, and the result transformed the battlefield. Cavalry suddenly became obsolete, and the rapid rate of fire increased the harvest of death many times during World War I.

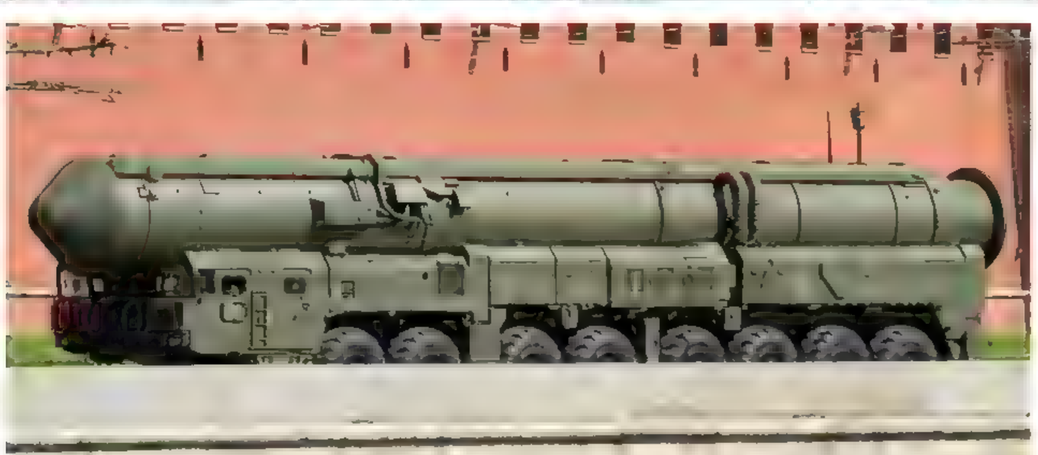
The crucible of the Great War also introduced the horror of chemical warfare. Clouds of chlorine and other gases, delivered by artillery shells, inflicted terrible injuries, leaving soldiers gasping for breath or blinded. Replacing the cavalry and bringing with it armour, mobility and firepower, the tank made its combat debut at the Somme in 1916. In later wars, the tank became a mechanised monster, wielding a destructive mailed fist. The German Panzer and Tiger, and the Allied Sherman, T-34, Matilda, and Churchill tanks became legendary in World War II. On the battlefields of the First Iraq War, the M1 Abrams, Challenger 2, and T-72 did battle, while armoured fighting vehicles (AFV) such as the M2 Bradley came into their own.

During World War II, the machine gun became even more prominent, particularly with the spectacular rates of fire achieved by the German MG-34 and MG-42, while the American Browning .50-calibre became the stuff of legend and remains in production today. German infantrymen carried the first truly operational assault rifle, the Sturmgewehr 44, which gave rise to a generation of automatic weapons. The best known of this genre is the ubiquitous AK-47. World War II also brought the semi-automatic M-1 Garand rifle into widespread usage with American troops.

At sea, the navies of the world were transformed with the introduction of the iron warship. When the USS Monitor and the CSS Virginia did battle in Hampton Roads, Virginia, during the American Civil War, the Age of Sail abruptly ended. All wooden ships became obsolete. A global naval arms race ensued, and the British Royal Navy set a new standard of floating firepower with the introduction of the battleship HMS Dreadnought in 1906. In turn, by World War II, the preeminence of the

This harrowing image depicts a British soldier on the WWI battlefield of Ypres, dying from chemical weapons exposure while doggedly manning his machine gun

"FROM THE ARMS RACE CAME THE DOCTRINE OF MUTUALLY ASSURED DESTRUCTION (MAD)..."



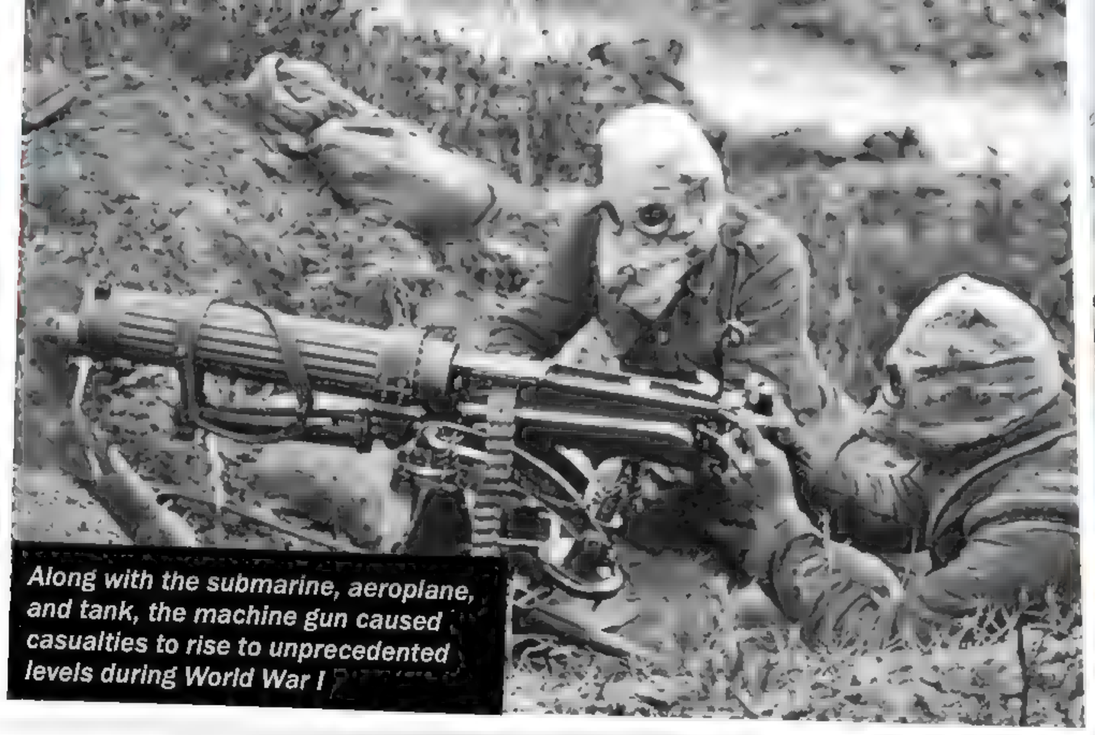
A Russian Topol-M intercontinental ballistic missile. Its range is 2,000km-10,500km

A DIFFERENT BIG BANG

In the early days of US involvement in World War II, dozens of civilians working at the Carnegie Institution in Washington DC, and the Applied Physics Laboratory at Johns Hopkins University in Baltimore, Maryland, developed a mechanism that – though not a weapon in itself – changed the prosecution of modern warfare forever.

Their invention was the proximity fuse, and its premise was simple. Prior to its development, the distance to a target had to be estimated and dialled into the shell by hand. With the radio receiver and transmitter in the proximity fuse, a shell needed only to come within 75 feet or so of a target to detonate. The result was astounding. In naval gunfire, for example, the finest gunners ordinarily fired 2,500 rounds or more to achieve one hit on an incoming aircraft. With the proximity fuse, the cruiser USS Helena brought down two Japanese dive-bombers off Guadalcanal in the spring of 1942. The gunners fired only 50-60 rounds, not every one of them equipped with the new fuse.

The impetus for the proximity fuse came from Carnegie physicist Merle A Tuve, who convinced government bureaucrats to invest in research in the summer of 1940. Sometimes overlooked, the shell equipped with the proximity fuse was essentially the world's first smart weapon. General George S Patton Jr observed, "The new shell with the funny fuse is devastating. I'm glad you all thought of it first."



Along with the submarine, aeroplane, and tank, the machine gun caused casualties to rise to unprecedented levels during World War I

A British Mark I tank in action at the Battle of Cambrai on the Western Front of the First World War, 1917. This was the world's first tank

battleship was eclipsed with the introduction of the aircraft carrier, which projected air power across vast oceans. During the World Wars, the submarine became a stealthy threat. Sinking tons of shipping on the high seas, the German U-boat menace nearly brought Britain to its knees twice. The modern submarine fulfills both the roles of attack and ballistic missile platform. Today's navies rely on offensive and defensive weapons systems that eliminate an enemy threat that is invisible to the naked eye.

From the Crimea to the Japanese invasion of Port Arthur (now Lüshunkou District, Dalian, China) during the Russo-Japanese War of 1904-05, the trenches of World War I, and beyond, artillery came into its own. British industrialist Henry Bessemer developed a process to mass-produce steel with enough strength to withstand the pressure of firing heavy calibre shells, and field guns wreaked havoc against infantry concentrations and other targets from that time forward. Rifled guns reduced heavy brick fortifications to rubble and forced the redesign of strongpoints. In turn, fortresses bristled with guns for defence against threats from land and sea. The Japanese utilised heavy guns of 280mm (11 inches) or larger at Port Arthur, and the weight of artillery bombardment set the tone for land operations to come.

Along with the development of artillery, the advent of the missile during World War II has shaped every conflict since the mid-20th century. Nazi Germany perfected the V-1 Buzz Bomb, powered by a pulse-jet engine, and the V-2 rocket mounted a 1,000-kilogram (2,200-pound) warhead – the world's first ballistic missile. The Germans also produced guided and unguided missiles, the forerunners of the modern cruise missile that exhibits the 'fire and forget' feature of multiple weapons systems. The era of smart weapons followed, as missiles now display pinpoint accuracy due to advanced guidance systems.

At the end of World War II, the Atomic Age was born. A pair of nuclear bombs, unleashed by the US, devastated the Japanese cities of Hiroshima and Nagasaki, and the development of nuclear weapons radically changed the world's perspective on warfare. The global superpowers (then the British Empire, United States and USSR) developed vast Cold War nuclear arsenals, including bombs delivered by aircraft, missiles fired from submarines, and intercontinental ballistic missiles (ICBMs) capable of carrying multiple warheads for delivery against separate targets. The hydrogen bomb followed within a short time, employing a combined thermonuclear fusion process rather than fission alone, and capable of destruction many times greater than that of earlier nuclear weapons. From the arms race came the doctrine of Mutually Assured Destruction (MAD), which forced the major powers to come to the negotiating table to curb the proliferation of nuclear weapons. Today, at least nine countries possess nuclear weapons capabilities.

Among the most influential of military technologies, the aircraft has revolutionised the conduct of modern warfare. Within months of the first successful demonstrations of manned flight, the military implications of the aircraft were readily apparent. First used

MILESTONES IN MODERN WEAPONRY

Defining moment
BATTLE OF HAMPTON ROADS
9 MARCH 1862

During the American Civil War, the ironclad warships USS Monitor and CSS Virginia, belching cannon fire and smoke, duel to a draw in the waters of Hampton Roads, Virginia. Prior to the battle, the Virginia had rammed and sunk one wooden warship of the US Navy and run another aground. First commissioned in the shape of the French naval ship La Gloire in 1860, the new ironclad ships usher in an era of rapid development for the world's modern navies, characterised by steel and heavy weapons.

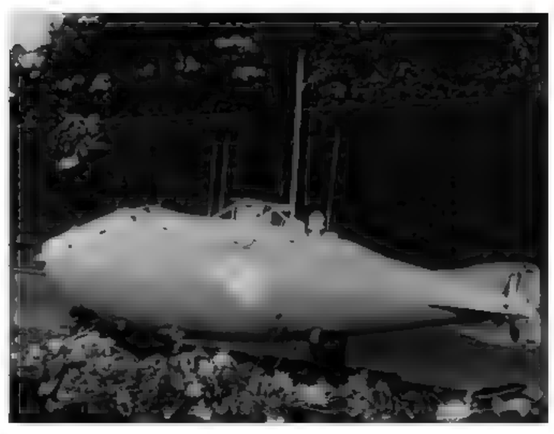
Defining moment
COMBAT DEBUT OF THE TANK
15 SEPTEMBER 1916

The first operational tanks enter combat with the British Army at Fleurs-Courcelette, an engagement during the Battle of the Somme in World War I. A development project originally assigned to the Royal Navy, the tank later appears with Allied forces in large numbers, and the limited German response produces only about 20 of the mammoth A7V, while the French produce the Schneider, Saint Chamond, and the versatile Renault FT-17. The tank embodies speed, armour protection and firepower, becoming a primary weapons system in future wars as technological advances provide heavier weapons, more efficient powerplants and better armour plating.

THE MINIÉ BALL
French Army Captain Claude-Étienne Minié introduces the bullet that revolutionises the use of small arms in combat. Grooved to cause the projectile to spin in flight, its range and accuracy increase the lethality of the rifle immensely.
1849

THE MAXIM GUN
American-born British inventor Hiram Maxim introduces the first fully automatic machine gun and changes the course of land warfare. Adopted by armies the world over, the machine gun becomes one of the 20th century's deadliest weapons.
1884

HOLLAND AND THE SUBMARINE
Inventor John Holland launches the first submarine with the power to run submerged for an appreciable distance. The submarine becomes one of the principal weapons of the World Wars and a platform for delivering nuclear missiles.
7 MAY 1897



THE BULLETPROOF VEST
Polish inventor Casimir Zeglen develops the world's first bulletproof vest, the forerunner of other such protective gear composed of composite materials. Zeglen's invention utilises woven silk, which captures the bullet and eliminates the need for steel plating.
1893

in combat during the Italo-Turkish War of 1911-12, the aircraft came into its own during World War I, initially for observation and then as a bomber and fighter. From the biplanes of the Great War, sleek monoplanes developed during the interwar years and dominated the skies during World War II. Swift fighters engaged in swirling dogfights, while bombers rained destruction on enemy cities. Perhaps the air raids of the Blitz and the following devastation of German and Japanese cities provides the best evidence of total war in an industrialised age – war that targets civilian populations, production and infrastructure.

During World War II, the Jet Age came into being as new engines provided greater power than earlier piston designs, such as the legendary Supermarine Spitfire and the North American P-51 Mustang. The German Messerschmitt Me-262 was the world's first operational jet, while the US, Britain, France, and the Soviet Union deployed their own types throughout the Cold War era. The latest combat aircraft employ stealth technology, cloaking them from enemy radar. These aircraft are often multi-purpose, serving in fighter, bomber and reconnaissance roles.

The steady advance of military technology during the last 150 years has brought the realm of space into the theatre of war. While nations grappled with the threat of nuclear annihilation during the Cold War, they invested tremendous resources in offensive weapons development and sought effective defensive measures against ICBMs as well. During the 1980s, US President Ronald Reagan introduced his anti-missile Strategic Defence Initiative, popularly known as 'Star Wars', and many nations have deployed satellites for strategic military purposes, notably navigation and monitoring, giving rise to the civilian GPS technology that so many of us rely on.

The atomic bomb dropped on Nagasaki on 9 August 1945 devastated the city and caused thousands of casualties, some of whom died slowly and painfully from radiation sickness

"...THE ADVENT OF THE MISSILE DURING WORLD WAR II HAS SHAPED EVERY CONFLICT SINCE THE MID-20TH CENTURY"

Defining moment

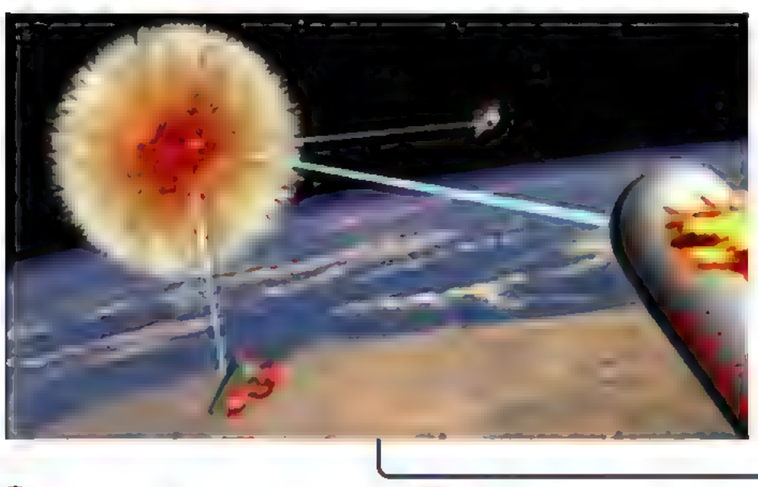
THE ANTI-SATELLITE LASER
OCTOBER 1997

Along with the development of nuclear weapons, an effort to mount a practical defence against them emerges during the Cold War. In the 1980s, US President Ronald Reagan advocates such a defence system, dubbed 'Star Wars'. Emphasis shifts to anti-satellite laser technology during the 1990s, and the US tests a ground-based anti-satellite laser system before the end of the decade. Countering atmospheric dissipation of the concentrated laser beam so that it's capable of destroying orbiting satellites is a priority, and testing continues into the 21st century accompanied by a continuing strategic effort to mount an effective airborne missile defence system.

A HARDENED STEEL

When Henry Bessemer, a noted British industrialist, visited Emperor Napoleon III of France in 1854, he brought with him an invention: an artillery shell that was heavier than conventional ordnance and grooved at its base to engage artillery barrel rifling. Bessemer told the emperor that the shell would deliver greater firepower more accurately than any other contemporary shell. There was only one problem: even though Napoleon III was enthusiastic, his generals were not impressed. Artillery barrels of the day were made of cast iron. Steel was costly, and cast iron was much cheaper. However, it could not withstand the pressure generated internally with the firing of Bessemer's new shell. In the heat of battle the barrels would explode with catastrophic results. So to sell his new artillery shell, Bessemer was confronted with the task of producing high-grade steel cheaply and in quantity to make stronger gun barrels.

The existing steel making process required six weeks to heat wrought iron with charcoal and then roll it into bars for industrial use, and only produced small quantities that were inadequate for military applications. Bessemer discovered that blowing air through pig iron, oblong blocks of crude iron taken directly from the smelting furnace, removed some carbon impurities. Repeating the process produced purer, stronger steel without requiring an external heating source. By the height of the Crimean War, Bessemer was producing 30 tons of high-quality steel in only half an hour. His breakthrough helped spark the second Industrial Revolution and changed the conduct of warfare. Although he never sold his artillery shell, Bessemer became wealthy with the manufacture of high-grade steel.



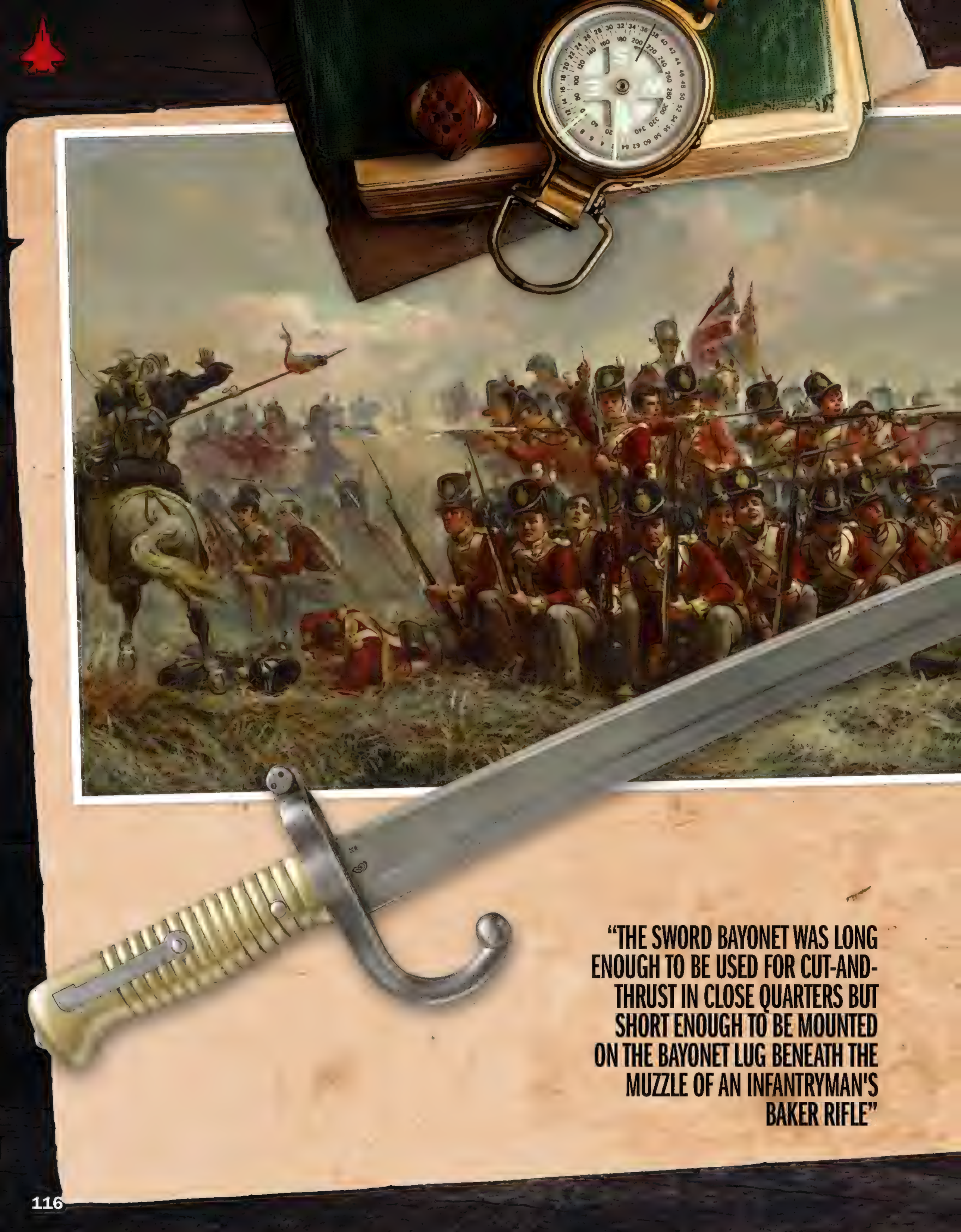
THE FIRST OPERATIONAL JET
The German Messerschmitt Me-262 takes flight for the first time. Although it becomes operational too late to influence the outcome of World War II, the world's first jet aircraft ushers in a new age of aerial combat.
18 APRIL 1941

THE ATOMIC AGE
US aircraft drop atomic bombs on the Japanese cities of Hiroshima and Nagasaki, unleashing the destructive power of the atom. The Cold War and a nuclear arms race ensue following the end of World War II.
AUGUST 1945

THE HYDROGEN BOMB
The small-scale 'George' nuclear fusion test during US Operation Greenhouse leads to the successful detonation of the hydrogen bomb, the world's first thermonuclear weapon. The hydrogen bomb delivers a nuclear payload much larger than earlier devices.
MAY 9, 1951

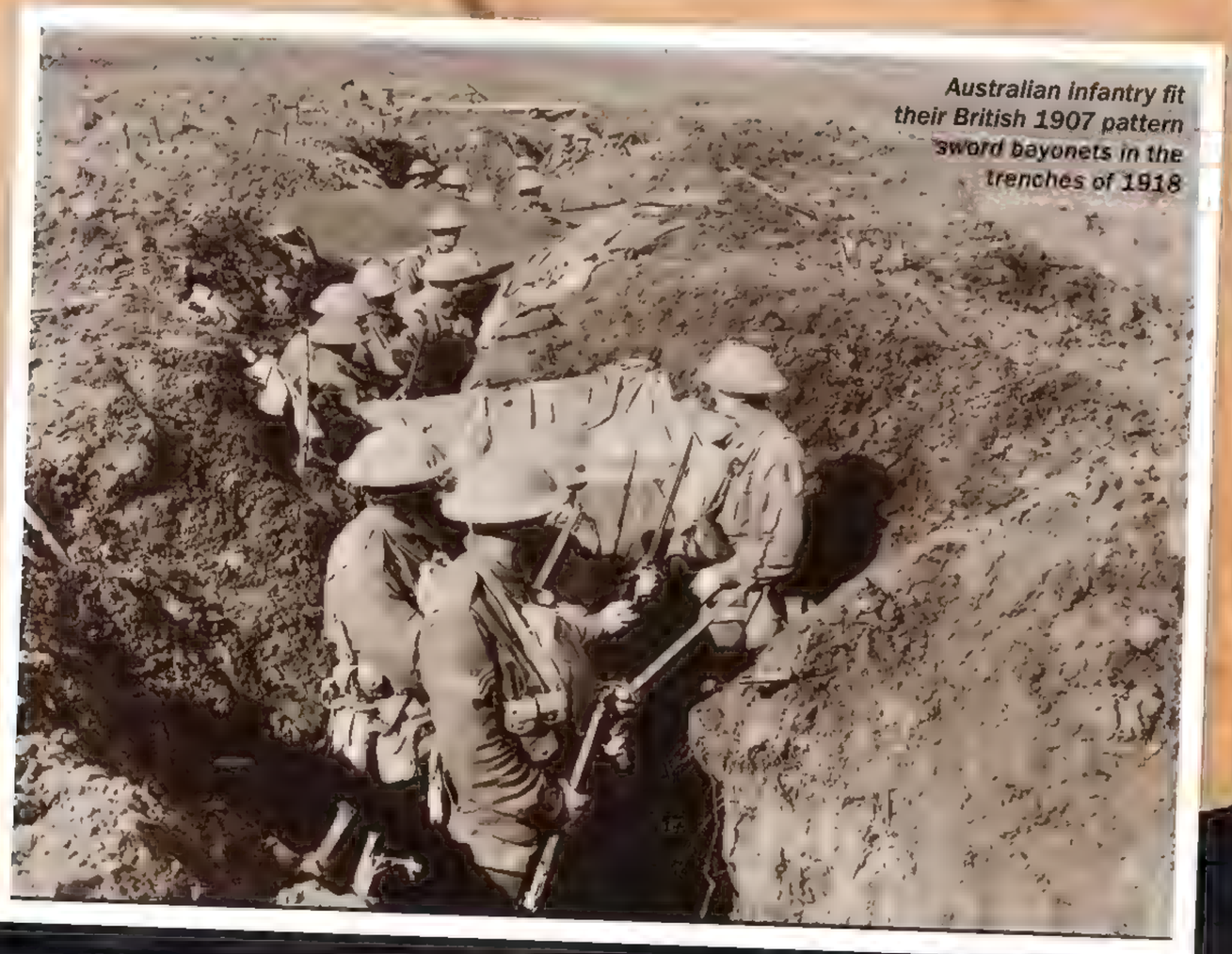
MIRV ENTERS THE ARMS RACE
MIRV (Multiple Independently-targeted Reentry Vehicle) technology becomes operational on US ICBMs (Intercontinental Ballistic Missiles), allowing a single missile to deploy warheads at numerous targets. To date, Russia, China, the United Kingdom, the US, Israel and France possess the technology.
1970

PLASMA ACOUSTIC SHIELD SYSTEM
Stellar Photonics tests the Plasma Acoustic Shield System (PASS) intended to disorient an enemy with mid-air explosions, high-powered speakers or intense light. Although not classified as a weapon, its ability to distract or incapacitate is extraordinary.
2008



"THE SWORD BAYONET WAS LONG ENOUGH TO BE USED FOR CUT-AND-THRUST IN CLOSE QUARTERS BUT SHORT ENOUGH TO BE MOUNTED ON THE BAYONET LUG BENEATH THE MUZZLE OF AN INFANTRYMAN'S BAKER RIFLE"

Armed with socket bayonets, British infantry form a square to receive a cavalry charge at Quatre Bras (1815)



Australian infantry fit their British 1907 pattern sword bayonets in the trenches of 1918

BRITISH SWORD BAYONET

19TH CENTURY

Though the age of the firearm was now in full swing, across the early 1800s the slow reload of flintlock rifles left infantry just as vulnerable to cavalry charges as they had been 1,000 years earlier.

The sword bayonet was long enough to be used for cut-and-thrust in close quarters, but short enough to be mounted on the bayonet lug beneath the muzzle of the British infantryman's Baker rifle. Shorter than the musket, the sword bayonet gave the Baker rifle the reach to act as a spear and, bristling with bayonet points, infantry would be ordered to form up into a tightly drilled square in order to receive a charge.

Unlike earlier spiked socket bayonets, the sword bayonet had a groove along the side of the blade, which allowed blood to drain and prevented the blade from becoming wedged in the body.

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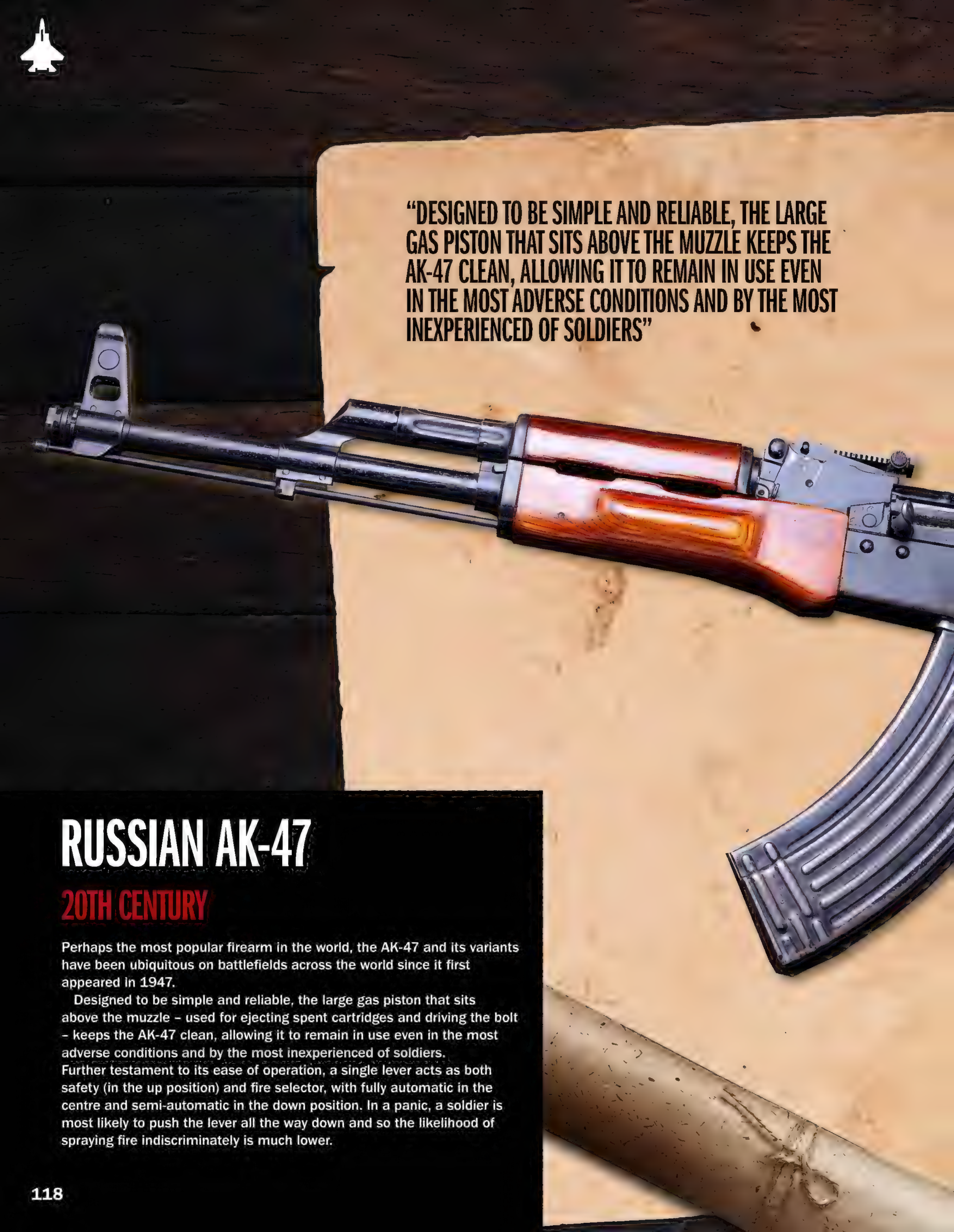


RUSSIAN AK-47

20TH CENTURY

Perhaps the most popular firearm in the world, the AK-47 and its variants have been ubiquitous on battlefields across the world since it first appeared in 1947.

Designed to be simple and reliable, the large gas piston that sits above the muzzle – used for ejecting spent cartridges and driving the bolt – keeps the AK-47 clean, allowing it to remain in use even in the most adverse conditions and by the most inexperienced of soldiers.

Further testament to its ease of operation, a single lever acts as both safety (in the up position) and fire selector, with fully automatic in the centre and semi-automatic in the down position. In a panic, a soldier is most likely to push the lever all the way down and so the likelihood of spraying fire indiscriminately is much lower.

US Marines in the Iraq War burn piles of seized Tabuk 6.62mm assault rifles. Testament to how widely licensed the AK model is, the Tabuk is the Iraqi variant of the Yugoslav Zastava M70, which is a license of the Soviet AK type

Iraqi soldiers train with an AK variant in May 2016. Rugged and easy to keep clean, they remain popular in dusty environments such as the Middle East

Ready for action, a row of Supermarine Spitfires wait for battle on an airfield during World War II

BRITISH SUPERMARINE SPITFIRE

20TH CENTURY

Indisputably the most iconic combat plane of the 20th century, the Supermarine Spitfire was designed for speed, with a low profile and elliptical curved wings that made it one of the fastest planes in the world when it first rolled out onto the airfield in 1936.

Though less numerous than the Hawker Hurricane, the Spitfire earned its reputation in dogfights with the Luftwaffe during the Battle of Britain (1940) and served with distinction in a variety of roles and variants throughout World War II (1939–1945).

Whether deployed as the carrier-launched Seafire or for mapping German defences as a covert photo-reconnaissance aircraft, the Supermarine Spitfire ensured Allied air superiority, and it was from the skies that the war on land and sea was ultimately won.

A Spitfire is lowered onto the carrier deck of USS Wasp, May 1942. As Malta came under air assault from Italian and German forces, USS Wasp ferried 47 Spitfires of No. 603 Squadron RAF to Malta as part of Operation Calendar

TRENCHES

19TH CENTURY

Though inseparable in the imagination from the First World War (1914–1918), what we'd now recognise as large-scale trench warfare emerged in the late 19th century with the Crimean War (1853–1856) and the American Civil War (1861–1865).

Advances in explosive artillery, machine guns and the increased rate of fire from small arms made flesh and bone seem flimsier than ever. The American Civil War in particular saw increasingly elaborate earthworks thrown up to protect men from this hail of shot and shell.

By the end of the Great War, all parties on the Western Front were proficient at excavating expertly engineered lines of trenches, reinforced with sandbags and concrete block houses, lined with firing steps and ladders, and connected by labyrinths of communications trenches, support trenches, roads and railway lines.

Confederate trenches and earthworks at Petersburg, Virginia. The walls are reinforced with bundles of sticks called fascine that help the trench keep its shape

CAMBRAI

When the British Army deployed tanks to change the pace of the First World War, they changed the face of it instead

WORDS JONATHAN HATFULL

By 1917 the British Army's notions of war had changed entirely. Any romantic ideals of the glory of the open battlefield had been trampled in the blood-drenched, rain-slicked mud and barbed wire of the trenches of the Somme. Men fought and died for yards that felt like inches. Three years of almost imperceptible movement in the fields of France had finally pulled the wool from British commanders' eyes.

With change so desperately needed, it's not surprising that the plan of attack at Cambrai was the product of ideas from three groups. British preliminary bombardment meant German forces were always alerted to the fact an attack was imminent, enabling a tactical retreat before a counter-attack. In August 1917, artillery commander Brigadier General Henry Hugh Tudor proposed 'silent registration' of guns, bringing the artillery to the battlefield

CAMBRAI, FRANCE 20 NOVEMBER - 7 DECEMBER 1917

WHO
The British Third Army, including Commonwealth and American troops, up against the German Second Army.

WHAT
The first major tank battle of the First World War, seeing hundreds of British modified Mark IV tanks deployed.

WHERE
Cambrai, France. Part of the Hindenburg Line, it was heavily defended and a key supply station for German forces.

WHY
Attempting to break the cycle of trench warfare, the assault was meant as a 48-hour lightning attack to gain key positions.

OUTCOME
An important lesson in the co-operation between tanks and infantry, but one that came at a huge cost with very few tactical gains.

British soldiers photographed during the battle. The photo's original caption reads: "Down in a shell crater, we fought like Kilkenny cats"

***Right:** Field Marshal Douglas Haig was the most senior British commander during WWI*

***Below:** General Julian Byng, commander of the British Third Army, pictured in April 1917*

without alerting the enemy. This process would be greatly assisted by the use of the No.106 instantaneous fuses, which meant that shells would detonate immediately on impact.

Meanwhile, the Tank Corps' Brigadier General Hugh Elles and Lieutenant Colonel John Fuller were desperate for a chance to show their machines' worth. Fuller was convinced they would be capable of conducting lightning raids to smash resistance and drive the British line forward. This dovetailed neatly with Tudor's plan, as General Julian Byng, head of the Third Army, recognised. Byng turned his eye to Cambrai, a quiet area used by the Germans as supply point. While it was very well defended with the deep trenches of the Hindenburg Line and barbed wire, an attack would certainly be unexpected despite the area's strategic value.

With six infantry divisions, five cavalry divisions and nine tank battalions, more than 1,000 guns were mustered for the attack. There would be a front of around 10,000 yards, covered by the III and IV Corps of the Third Army, which would be widened as the attack progressed. The III Corps had to break the Masnières-Beaurevoir line, enabling the cavalry to circle around Cambrai and cut it off from reinforcements before 48 hours had passed. Obviously, secrecy was paramount.

The Mark IV tanks were divided into "male" and "female" groups, with the former having four Lewis guns and two six-pounder Hotchkiss naval guns. The latter were each fitted with six Lewis guns. Without the naval guns, the "female" tanks were lighter, at 26 tons, while the "males" weighed 28. The crews also noticed that while the males had a door at the back, the female tanks had doors closer to the ground that were harder to get out of in an emergency. Eight men shared the single space with the engine, while the machine was only capable of reaching a speed of 3.7mph, and more typically around 1mph over bad terrain.

The tanks would lead, providing cover for the infantry as they crushed the barbed wire effortlessly under their tracks. As for navigating the trenches, each tank carried a fascine – a bundle of wood and branches, which would be deposited into the trench in order to fill it, so that the vehicle could drive over it. Meanwhile, a grapnel was fitted to some of the tanks to enable them to drag away the crumpled wire as they went, so that the path was clear for the advancing cavalry.

"WITH SIX INFANTRY DIVISIONS, FIVE CAVALRY DIVISIONS AND NINE TANK BATTALIONS, MORE THAN 1,000 GUNS WERE MUSTERED FOR THE ATTACK"

Several things needed to go very right in order for this so-called "clockwork" battle to work. Haig had fallen victim to overreaching in previous campaigns and he was determined that the Cambrai offensive have limited objectives and stick to its time frame. Minimising losses was crucial – even more so when he was forced to send two divisions to support the Italian front. Co-operation and communication between the divisions was also vital, as the battle's events would prove.

The battle rumbles to life

The attack began at 6.20am on 20 November as the artillery began shelling. With this stunning overture, the tanks advanced into the fog. The gentle incline made things very easy for the drivers, while the infantry marvelled at the ease with which the tanks rolled over the barbed wire as they followed them into battle, as did the men inside.

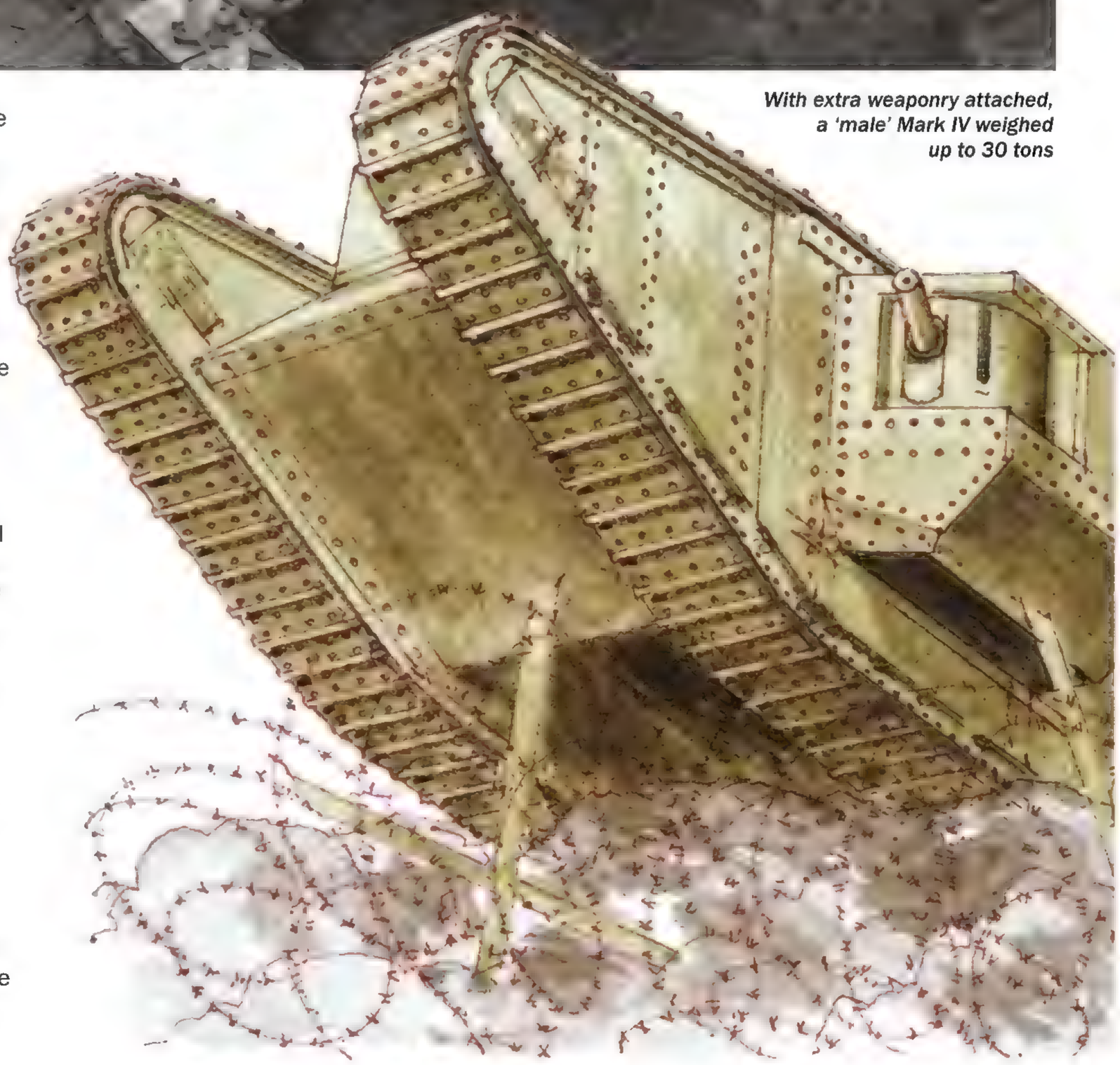
The initial advance seemed to be going impossibly well. The "clockwork battle" was living up to its name as the Germans were taken completely by surprise by this sudden, shocking attack. The British artillery kept up a devastating rate of fire, as much as possible given the two-rounds-per-minute rule to avoid overheating. The advance was also supported by the Royal Flying Corps, whose targets were on the ground rather than in the air. As the pilots braved machine-gun fire to drop their payloads, the weather worked against them. An Australian squadron pushed through

Men from the 11th Leicester Regiment in a captured enemy trench at Ribecourt

punishingly thick fog at Havrincourt, barely able to see one another, let alone their targets. If their planes went down, they had to fight their way back to their lines, as Lieutenant Harry Taylor was forced to do, picking up the weapon of a fallen man and setting out to find support.

This isn't to say there was no resistance. A myth sprung up as the days went on about a German gunner who held the enemy at bay entirely by himself. That myth does a disservice to the determination and skill of the men who suddenly found themselves on the back foot. Some of the troops stationed near Cambrai had come from the Russian front and had never seen a tank before. It's impossible to know what these soldiers thought as the metal leviathans rolled towards them, but they fell back on their training, resisting where possible before making a tactical retreat.

Before long, communication began to prove an issue. When the tanks worked in tandem with the infantry, such as through Havrincourt and Graincourt, things went very smoothly. Elsewhere, infantrymen were forced to bang on the door of the tanks to get their attention, while confusion over objectives led to groups of infantry being forced to take key positions without artillery support. However, sitting in these slow-moving targets had its own terrors. They drew the bulk of enemy fire and if the engine gave out, whether due to attack, water in the fuel tank, or even a fire, the tank became a sitting duck. Once engaged in combat, the inside of the tank would become incredibly



With extra weaponry attached, a 'male' Mark IV weighed up to 30 tons

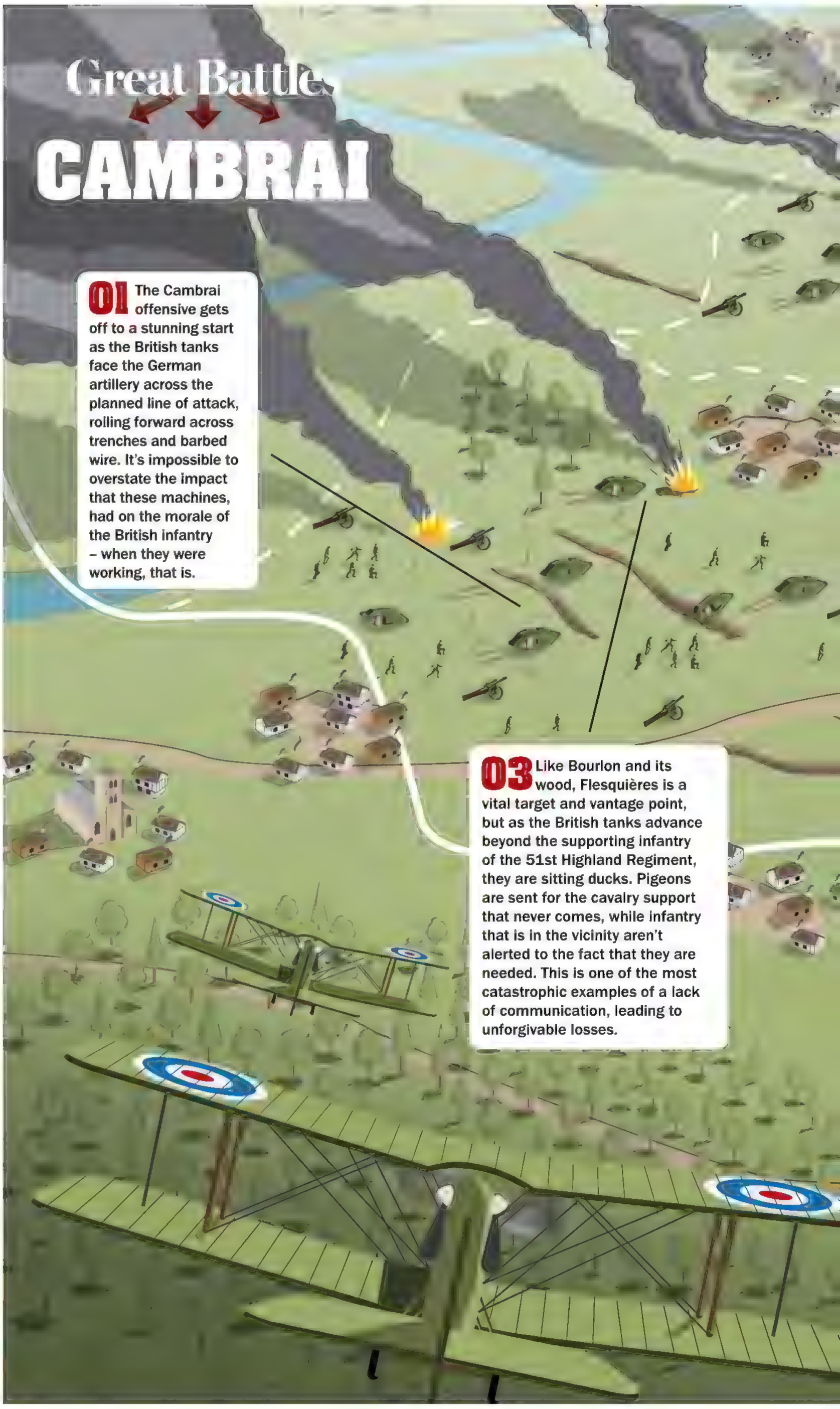
hot as the guns began to fire and the sound of their doing so was deafening. Visibility was shockingly poor, while the fact that most tanks had to stop in order to turn meant that they were a popular target on the battlefield.

Nevertheless, the speed with which they were taking ground was intoxicating; each trench taken and each line of wire cleared was another step towards the objective and morale had rarely been higher. As the tanks moved further away from their lines of reinforcement, establishing a clear road and lines of communication back became crucial. However, the supply mules proved nearly useless in the tangle of mud and wire, while the narrow roads quickly became clogged with traffic back and forth, ferrying wounded and prisoners.

The Third Army consolidates

Despite the ground gained, the first day of the battle ended with some major concerns. While crossing trenches had proved easy enough for the tanks, moving past the St Quentin Canal was another matter indeed. A crucial bridge at Masnières had been crushed by a tank that had attempted to cross the canal, stopping the planned infantry advance, while another had been mined. The cavalry was delayed by the clogged roads, while a lack of communication frequently meant they were stranded or forced to retreat. A lone squadron of Canadian cavalry realised that they were the only unit to make it across the canal at Masnières and were then forced to find their way back around and across the water.

Meanwhile, the key village of Flesquières had not been captured after the advancing tank divisions became separated from the infantry of the 51st (Highland) Division. With no infantry support, the tanks were target practice for the gunners at Flesquières ridge and suffered huge losses. Messengers from the battlefield, some of whom walked the two miles on foot, struggled to convince their commanders that Flesquières had not yet been captured. Crucially, Major General George Montague Harper refused to commit any of the troops held in reserve to take the objective.



OPPOSING FORCES

BRITISH

LEADERS
Field Marshal Douglas Haig, General Julian Byng
INFANTRY
2 Corps (6 divisions)
CAVALRY
5 divisions
TANKS
476 (378 fighting tanks)
PLANES
14 squadrons
RESERVES
4 divisions
GAME CHANGERS
378 fighting tanks that enabled the British to move forward at an incredible rate on the first day of fighting.

GERMANS

LEADERS
General Georg von der Marwitz, Crown Prince Rupprecht of Bavaria
INFANTRY
1 Corps
PLANES
Baron Manfred von Richtofen's Jagdgeschwader 1 (approx. 40 planes)
GAME CHANGERS
The air force led by Baron Von Richtofen that arrived on the 23 November to combat the RFC and attack the British ground forces.

04 Some of the most brutal and devastating fighting breaks out in Bourlon Wood. Capturing it is crucial for the British as it's an excellent vantage point for German firepower. Once British forces enter the trees, the infantry are on their own and some wounded men will be wait days to be rescued. Facing fierce resistance from German infantry, not to mention shelling and aircraft fire, Bourlon Wood continues to be fiercely contested at a terrible cost.
05 Few locations exchange hands as often as the small village of Fontaine. It's strategically important but painfully open to attack, as the British learn shortly after taking it. By the 26 November, the Grenadier Guards manage to take Fontaine despite incredible losses, but the lack of support means they're forced to retreat not long after their victory.
02 If the British forces are to circle around from the south, it is crucial to cross the St Quentin canal at Masnières. This initiative fails spectacularly when bridges are either been mined by the Germans or collapse under the weight of the tanks. All supplies and reinforcements now have to come by road, which quickly becomes choked.
06 The German counterattack on 30 November takes place all across the line, but the speed with which they strike Gouzeaucourt seems staggering. British troops fall back and take shelter in a nearby quarry, but soon realise that they have given themselves no cover, with only one option remaining. The number of British prisoners taken is incredibly high.

The second day required consolidation and advancement. Masnières was taken in the morning, but as a salient it was open to a punishing amount of shell and machine-gun fire, and the German air force soon reappeared to make life very difficult for the British troops. Meanwhile, the tanks had used all their improvised wooden fascine bridges on the first day, which made crossing the trenches difficult, and the infantry were reluctant to advance without them. Things looked much better for the IV Corps, which advanced on Flesquières dreading the prospect of a prepared German resistance, only to find it had been abandoned. In contrast, while the cavalry helped take Cantaing, it struggled to work in tandem with the tanks as planned. Similarly, as the tanks moved into villages, it became clear they were not prepared for street fighting. With no machine gun on the top of the tank (it would be introduced in 1918), they were horribly vulnerable to fire from second-storey windows. Still, Fontaine was secured despite heavy losses, leaving Bourlon and its dense wood as the next target.The offensive was on a knife edge without enough men to consolidate these gains. Fontaine was incredibly vulnerable, but was refused any artillery support and destroyed bridges made moving supplies incredibly difficult. Meanwhile, the German vantage points of Bourlon and Bourlon Wood posed a serious threat to the British. After a last-ditch effort ordered by Byng to push through, the order came to halt and dig in. When Haig learned of the attack's successes and failures, he decided to junk the 48-hour time limit and continue the advance. He toured the battlefield, congratulating the men and helping to spread the myth of the lone German gunner at the Flesquières ridge, as that was surely a better explanation for the number of ruined British machines on the battlefield than the alternative. During this apparent lull on 22 November, German forces rushed Fontaine and retook it. Resistance was growing, and as the British dug in for the night in the miserable November cold they knew that their momentum was dripping away. Haig stressed to Byng that Bourlon and Fontaine must be captured by the end of 23 November.

Bitter fighting at Bourlon Wood

The fresh offensive was major, with 400 guns and 92 tanks, while the 40th Bantam Division was dispatched to relieve some of the exhausted men at the front. The tanks met fierce resistance in Fontaine, and were forced to withdraw, to the disapproval of Tanks Corps intelligence officer Captain Elliot Hotblack, who saw the effect their retreat had on the infantry's morale. Further down the line, German infantry made life hell for the tanks, finding the machine gunners' blind spots and throwing hand grenades inside, leaving the British soldiers trapped and burning.

Having reached Bourlon Wood with the help of the tanks, fighting through the thick wood was now the infantry's job alone. It was here that some of the most-intense and gruesome combat was seen. Running from tree to tree, with an unimaginable noise of ceaseless gun and artillery fire, a huge number of British soldiers were lost in Bourlon Wood.

"RUNNING FROM TREE TO TREE, WITH THE NOISE OF CEASELESS GUN FIRE, A HUGE NUMBER OF SOLDIERS WERE LOST"

***Above:** Tommies look on as British artillery arrives at Cambrai in December, 1917*

***Left:** German officers pose with a captured British tank in Cambrai. Hundreds of stranded or abandoned British machines were captured during the offensive*

***Right:** Manfred von Richtofen, known as 'The Red Baron', played a pivotal role from the air at Cambrai*

When the German forces were finally pushed out, they started shelling it. Meanwhile, both Bourlon and Fontaine remained in German hands despite attempts in the afternoon, but the casualties on both sides were horrific. As night fell, troops were sent to support the men in Bourlon Wood as counter attacks from the Germans continued well into the night. Haig told Byng that Bourlon ridge simply must be taken, so the Guard division was summoned to support and relieve the depleted forces.

Throughout 24 November, shelling and counterattacks continued on Bourlon Wood. Poor weather made it difficult for any RFC pilots to take to the skies and challenge the forces of the recently arrived Manfred von Richthofen, the Red Baron, whose planes rained fire on the wood. German efforts to grind down the soldiers in the wood continued throughout the day. Counterattack met counterattack, and 25 November saw further terrible lapses in communication and bloody skirmishes. Battalions without tank support were mown down by machine-gun fire at Bourlon, while an entire cavalry regiment ordered to wait within sight of the German artillery was shelled. A furious Haig ordered the capture of Bourlon and Fontaine by the 27 November, as German forces continued to push at the exhausted British throughout the night. A planned attack on 26 November was the cause of fierce argument between Major General Braithwaite, who bemoaned the lack of support and fresh troops, and Byng, who had his instructions from Haig. The attack went ahead, as Fontaine was taken at tremendous cost and targets in Bourlon Wood were reached. However, there was barely time to note the achievements before counterattacks drove the British forces back.

The German offensive

While skirmishes wore both sides down, the time had come for the major German counter-offensive after reinforcements had been arriving since the second day of the attack. Planned by Crown Prince Rupprecht of Bavaria, and widened by his superior General Erich Ludendorff, it was the first offensive planned against the British since 1915. Gas was fired into the wood two days before the attack, and at 6am on 30 November the assault began. Despite the warnings of some key officers, the British troops were simply not prepared for the assault at Gouzeaucourt, as German soldiers swarmed the British line and amassed prisoners. This was the first instance of the German stormtroop tactics, as the first wave of soldiers went around targets and cut them off as the further troops arrived.

As British soldiers realised what was happening, across all their lines, attempts were made to regroup and stand their ground as startled officers threw down their shaving kits and looked for their weapons. While German forces broke through in some places and were held up in others, communication broke down once again. There was simply no plan in place for this kind of counterattack, meaning that any attempts to fight back and reclaim ground were made on the hoof. Much as the Germans had offered fierce resistance, so too now did the British. At Les Rues Vertes, the inspired and determined defensive tactics of Captain Robert Gee meant that their position and the brigade's ammunition dumps were held. He set up a Lewis gun, organised bombing raids against the attackers, killed two Germans who had infiltrated his position and killed the guards, before charging a German machine-gun post with his two pistols. While seeking medical attention he was forced to jump into a canal and swim to safety. His actions earned him the Victoria Cross. As reinforcements arrived, the Guards Brigade retook Gouzeaucourt, while the forces in Bourlon Wood held determinedly to their positions. The conflict turned into a series of costly but unproductive skirmishes. As the days passed and the casualties mounted, Haig finally realised the necessity to fall back and form a line for the winter. He ordered a retreat on 3 December and by 7 December the lines had settled, with both sides having made considerable gains and losses in territory.

The British casualties numbered 44,207 killed, wounded or missing. The number of German losses has proved harder to calculate, with estimates ranging between 41,000 and 53,300. The battle has proven to be one of the most fertile grounds for myths of the First World War to form, but what is clear is that crucial lessons were learned in how important communication and co-operation between different divisions was. A lack of support in reserve, a lack of communication, and that terrible desire to overreach led to the attack's failure. While it may have been the first large-scale tank offensive in the war, this landmark came at a terrible cost to both sides.

Corbis; Alamy; Ed Crooks; Thinkstock

20 GREATEST MACHINES OF WAR

WORDS JACK GRIFFITHS

From the AK-47 to the Apache gunship, the military weapons and vehicles of the last century have transformed modern warfare on land, sea and air

The war machines of the 20th Century were endlessly inventive, and swung the pendulum for one side or another at crucial times. Just as a conflict looked as though it may grind to a stalemate, the order of things would be flipped on its head when a new invention made its timely debut on the battlefield.

The first machine guns brought about the end of marching in formation, while the arrival of the submarine blew the hierarchy of naval supremacy wide open.

The most effective war machines are usually created as a response to seemingly unbeatable odds. The stealth bomber was invented to fight back against increasingly effective radar systems, while tanks protected against the deadly machine gun fire that cut down infantry divisions in droves.

From the fall of once great empires, to the first truly global conflicts and the rise of new superpowers, the last century produced innovative, increasingly effective and terrifying military technology.

Listed here are just a few of the most devastating and revolutionary war machines that transformed the battlefields of one of history's bloodiest ever periods. Without the invention of these terrible but brilliant engineering marvels, the history of war would be very different indeed.

A stealth bomber on its first public flight in 1989. The B-2s cost a massive £86,100 ($135,000) per flight to operate

01 THE B-2 SPIRIT STEALTH BOMBER

IMAGINE AN AIRCRAFT ALMOST INVISIBLE TO RADAR THAT CAN STRIKE WITH EXPERT PRECISION FROM INCREDIBLY LONG RANGE. IT EXISTS, AND IT'S CALLED THE B-2

The world has come a long way since huge bombers blacked out the sky in the Second World War – now all you need is one. Among the most advanced of these bombers is undoubtedly the B-2 Spirit Stealth Bomber, which can reportedly do the job of 75 conventional aircraft. 21 of these modern aircraft were built (it would have been 132 if costs allowed) to strike heavily defended targets undetected.

An upgrade on the original Lockheed-Martin F-117 from 1981, its stealth is based on a smooth, contoured structure that keeps it partially hidden from radar. In addition, the bomber has systems that reduce its infrared, visual and electromagnetic visibility. A triumph of modern technology, underground bunkers can be struck by the craft's armaments, and pilot error has been almost eliminated with the on-board computer, which also prevents stalls. All these features were put to deadly use over Kosovo in 1999 and Afghanistan in 2001, with precision attacks against munitions factories. Today the B-2 provides the USA with opportunity for lethal strikes.

Stealth bombers have the potential to reduce the size of air forces drastically due to their versatility and superior armament. Their presence in the latter days of the Cold War dissuaded the onset of full-scale war, as a single strike form a B-2 in retaliation would cause mass destruction. Its appeal to the US Air Force continues today, with the bombers set to receive a £6.3 million ($9.9 billion) upgrade.

TECHNICAL ASPECTS

COUNTRY OF ORIGIN: USA
FIRST PRODUCED: 1989
WINGSPAN: 52.4m (172ft)
RANGE: 9,656km (6,000mi)
TOP SPEED: High subsonic
WEAPONRY: Nuclear warheads, advanced cruise missiles, Mark-84 bombs

KEY TECHNOLOGY

The advent of fully working military radar systems during the Second World War marked the need for stealth technology. The B-2 makes itself only partially invisible to radar, as its unique design is excellent at reflecting signals at a different angle, rather than straight back to its receiver. Additionally, the dark colour absorbs high amounts of light, while the tiny iron spheres used on its surface paint dissipate the radar energy as heat, so only miniscule amounts make it back to the radio transmitter.

Design, shape and even texture help B-2s avoid detection in a way that no craft has done before

02 MARK I TANK

THE FIRST TANK TO EVER SEE BATTLE CHANGED CONFLICT FOREVER, HELPING ELIMINATE THE STALEMATE OF TRENCH WARFARE

Only 250 of these metal beasts were created and even fewer saw battle on the muddy Western Front, but the Mark I signalled the dawn of a new type of warfare. With the stalemate of the trenches wearing down both sides in World War One, the tank was designed to be used as an armoured battering ram that could tear down enemy fortifications.

'Male' tanks were armed with three machine guns and one quarter-pounder gun, while the lighter 'female' versions contained six machine guns but less armour. The guns on the sides of this behemoth would mow down any infantry that would dare cross its path – at least that was the theory.

In its first few engagements, the Mark I regularly overheated and broke down and many were captured by the Imperial German Army. Conditions inside the tank were almost unbearable, with temperatures reaching 50 degrees Celsius (122 degrees Fahrenheit)

As the war continued, improved versions were put into production, such as the Mark IV, which had tougher armour and better weaponry

TECHNICAL ASPECTS

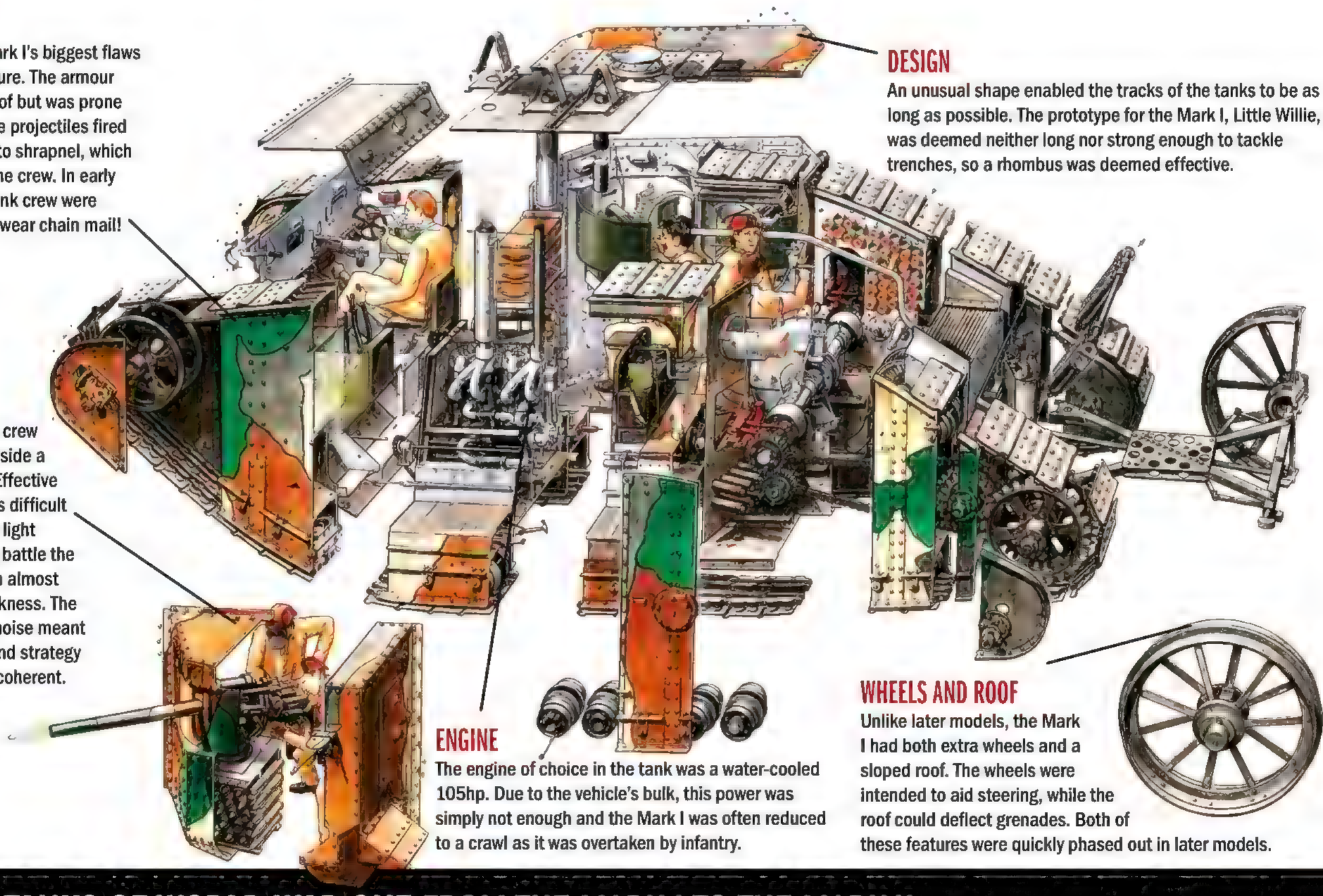
COUNTRY OF ORIGIN: Great Britain
FIRST PRODUCED: 1916
LENGTH: 9.9m (32ft)
WEIGHT: 28 tons
TOP SPEED: 5.9km/h (3.2mph)
WEAPONRY: Two six-pounder (57mm) guns and two air-cooled machine guns

ARMOUR

One of the Mark I's biggest flaws was its structure. The armour was bulletproof but was prone to splitting the projectiles fired at the tank into shrapnel, which could injure the crew. In early models the tank crew were compelled to wear chain mail!

CREW

An eight-man crew would work inside a Mark I tank. Effective teamwork was difficult as the lack of light meant during battle the interior was in almost complete darkness. The excruciating noise meant that tactics and strategy were often incoherent.



DESIGN

An unusual shape enabled the tracks of the tanks to be as long as possible. The prototype for the Mark I, Little Willie, was deemed neither long nor strong enough to tackle trenches, so a rhombus was deemed effective.

ENGINE

The engine of choice in the tank was a water-cooled 105hp. Due to the vehicle's bulk, this power was simply not enough and the Mark I was often reduced to a crawl as it was overtaken by infantry.

WHEELS AND ROOF

Unlike later models, the Mark I had both extra wheels and a sloped roof. The wheels were intended to aid steering, while the roof could deflect grenades. Both of these features were quickly phased out in later models.

HEAVY TANKS OF WORLD WAR ONE FROM THE MARK I TO THE MARK X

1915 'Little Willie' is tested as the first prototype of the Mark I.

April 1916 150 Mark I tanks are ordered to be built for the war in the trenches.

August 1916 The tanks make their debut just in time for the Somme offensive.

March 1917 The first Mark II tanks enter the fray, ready made with improvements over the original model.

May 1917 The vastly improved Mark IV is introduced onto the Western Front after the Mark III is used purely for training purposes.

July 1917 The new Mark VII is born after co-development with the USA. The VI had previously been cancelled after disagreements during production.

November 1917 476 tanks do battle at Cambrai and make significant advances into German territory across the Hindenburg Line.

April 1918 The first ever tank-to-tank battle sees Mark IVs combat German A7Vs.

September 1918 The Mark VIII is created after a joint project between the USA, Britain and France and remains in use until 1934.

1919 The last two 'Mark' models are created, with the IX a troop carrier. The X never makes it off the production line.

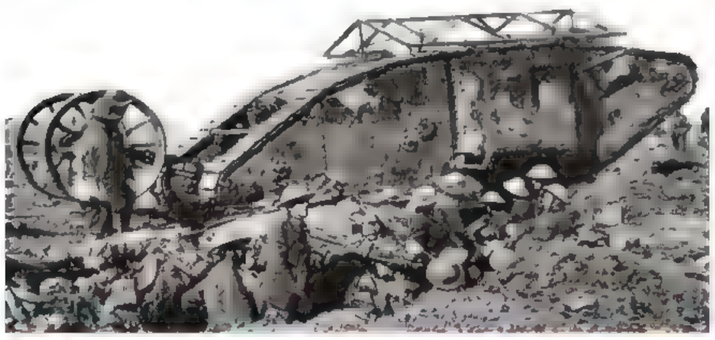
"TANKS STILL PLAY A MAJOR PART IN CONFLICTS ACROSS THE GLOBE"

and the loud machinery almost deafening. The potential was seen in the Mark I though, so later versions of the tank would succeed where it failed. After small advances in the II and III, the Mark IV was a vastly improved machine. Containing much thicker armour and a better engine, this would have the greatest impact on the Western Front, with its successor only available in the latter stages of the war.

The tank became the new cavalry of the battlefield, and the various 'Mark' models played a big part in the emergence of tank dominance. The Mark IX was the final tank of the line to be built, but the design was still used after the Great War. Mark Vs were used by both sides in the Russian Civil War and two were even found in the Battle of Berlin in the last days of the Third Reich.

Although initially unreliable, these tanks were pioneers for modern warfare. During the Battle of Kursk in 1943 over 6,000 tanks duked it out on the battlefield. The Nazi blitzkrieg would have stalled without them, and during the post-World War years, tanks still play a major part in conflicts across the globe – the Mark I is where all of them began.

The tank was a steep learning curve, so it included many different features, such as back wheels and extra roof protection

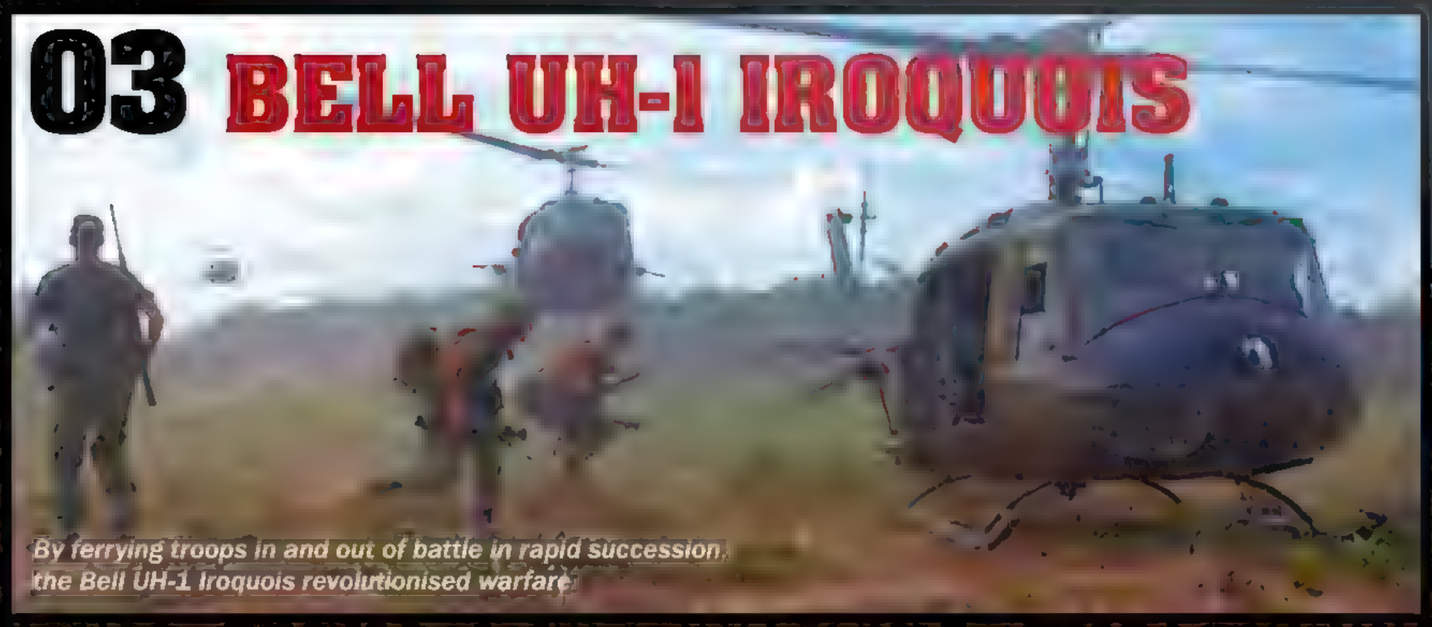


IN ACTION
THE BATTLE OF CAMBRAI: GIANT STEPS IN CATERPILLAR TRACKS

By late 1917 the role of tanks was increasing after many failed attempts to incorporate the mechanical monster in warfare. After struggling in the mud pits of the Somme, the dry plains of Cambrai were ideal for tank tracks.

The attack began on the morning of the 20 November as 476 of the machines advanced on German positions. The surprise attack was a resounding success, with German forces pushed back by 3.7 miles (6km) as the Hindenburg Line was breached for the first time during the war. On the first day alone, 8,000 prisoners and 100 guns were taken. However, a German counterattack nullified a sizeable portion of the British gains, as the deployment of tanks didn't quite wear down the German resistance completely. Nonetheless, the effectiveness of tanks had finally been proved and it was from here on out that the machine became an essential instrument of war.

03 BELL UH-1 IROQUOIS



By ferrying troops in and out of battle in rapid succession, the Bell UH-1 Iroquois revolutionised warfare

Nicknamed the Huey, this popular vehicle was vital for the deployment of American troops during the Vietnam War. Powered by a jet turbine that had never been installed on a helicopter before, 16,000 of these small vehicles were made and are still in use by the US Drug Enforcement Agency (DEA). These multipurpose helicopters could ferry up to 14 soldiers to and from battlefields. M-240 and Browning guns could also be attached.

04 TIGER II

The Tiger II was beset by manufacturing issues after being rushed off the Third Reich production line in an attempt to save the war

One of the deadliest tanks of the entire Second World War, the Tiger II would have dominated the battlefield if it weren't for its inherent production flaws. Feared by the Allied forces, this armoured beast quickly earned an aura of invincibility because of its thick armour and deadly 88mm turret gun. After the war, German Tiger II technology and prototypes were used for the future tanks of the 20th Century.

05 C-130 HERCULES

The C-130 is used in a variety of missions, from cargo drops to humanitarian efforts to troop deployment

Since its first flight in 1955, there hasn't been a military aircraft quite as reliable and adaptable as the Hercules. Currently operated by over 16 countries, the C-130 can carry various payloads up to over 20,000kg. Capable of operating over a range of 3,800km, it also fulfils the role of a long-distance cargo and transport aircraft perfectly, and there's still seemingly no need to replace it, even after 60 years in service.

06 M1 ABRAMS MEDIUM BATTLE TANK

A VETERAN OF WARS ALL OVER THE GLOBE SINCE 1979, THIS MACHINE HAS HELPED SHUNT ARMOURED GROUND WARFARE INTO THE MODERN ERA

The M1 Abrams battle tank was born after many failed attempts by the USA and Germany to create a tank to rival the Soviet T-72. By 1979 the US had decided to go solo and the outcome was the M1 Abrams, which excels in the three key areas of tank warfare: firepower, protection and mobility. It was produced six years after the Yom Kippur War, which saw the largest tank battle since the Second World War. An all-weather vehicle, it still plays a major role in the US Army, with the ability to go head-to-head with other armoured vehicles, while providing infantry support and mobile firepower.

It served during the Gulf War, in Afghanistan and the 2003 invasion of Iraq. In all these conflicts the Abrams outclassed its rivals with superior range, night vision and thermal sight capabilities.

Only nine were put beyond repair in the whole of the Gulf War, and the tank was essential to the success of Operation Desert Storm. Nearly 9,000 have been constructed for use worldwide and it's still in production after 35 years. Many have described it as being the first US tank to outclass its Soviet equivalent, and many variants on the original design have been made due to its success. The model M1A2 is undoubtedly the most advanced tank operating in the world today.

TECHNICAL ASPECTS

COUNTRY OF ORIGIN: USA
FIRST PRODUCED: 1979
LENGTH: 9.83m (32.25ft)
WEIGHT: 63,000kg (139,080lb)
TOP SPEED: 67km/h (42mph)
WEAPONRY: 120mm main gun, 12.7mm Browning M1HB anti-aircraft heavy machine gun, 2x 7.62mm M240 machine guns, 2x 6 smoke grenade discharges

***Above:** With tough armour all over, the M1 Abrams is highly resistant to most gun and missile fire*

***Below:** The power of the Abrams' 105mm main gun has been upgraded to a 120mm version on the M1A1 and M1A2*

KEY TECHNOLOGY

A tough duo of rolled homogeneous steel plates and Chobham laminate keeps the tank and its crew well protected. Neither HEAT warheads nor Sabot rounds can puncture the inner layer of the tank, and the structure also prevents injury by having armoured storage for the tank's own armaments. Better still, and much more inconspicuous, is an air-purification system dedicated to repelling biological attack.

07 AK-47 ASSAULT RIFLE

A COMBINATION OF A SUBMACHINE GUN'S FIREPOWER, WITH ALL THE ACCURACY OF A RIFLE

The distinctive curved magazine of the AK-47 is a common sight, with an estimated 100 million having been manufactured

The StG 44 was a German assault rifle produced at the tail end of World War II. If it were produced earlier, it would arguably have had a drastic effect on the fortunes of the Third Reich – that's how advanced it was. Combining the best qualities of a submachine gun and a rifle, it was one neat package of destruction. The Allies needed an answer – it came in 1947 in the form of the AK-47.

Created in the USSR by inventor and engineer Mikhail Kalashnikov, the weapon's ability to fire intermediate power cartridges at a rapid rate put it head and shoulders above the competition and paved the way for a wave of assault rifles such as the M16 and FAMAS.

It saw widespread action in the Korean War and was only upstaged in the Russian military by the mid-1970s with the development of the AK-74. There have even been stories that during the Vietnam War, US GIs stole AK-47s from the Viet Cong as they were still superior to the American equivalents. Currently, it's the weapon of choice for militant groups the world over due to its low cost and general all-round effectiveness. More AK rifles have been produced than all the other assault rifles combined and it remains a key player in warfare.

KEY TECHNOLOGY

The AK-47 was a phenomenon in so many ways and raised the bar in land warfare. The next stage of assault rifle evolution after the StG 44 took the first steps – its selective fire enabled it to be used in all areas of war, from street-to-street skirmishes to raids on fortified positions. An incredibly basic weapon for all its advances, the rifle only weighs four kilograms (9lbs). It can be stripped and cleaned in under a minute, making it invaluable for tense battlefield situations.

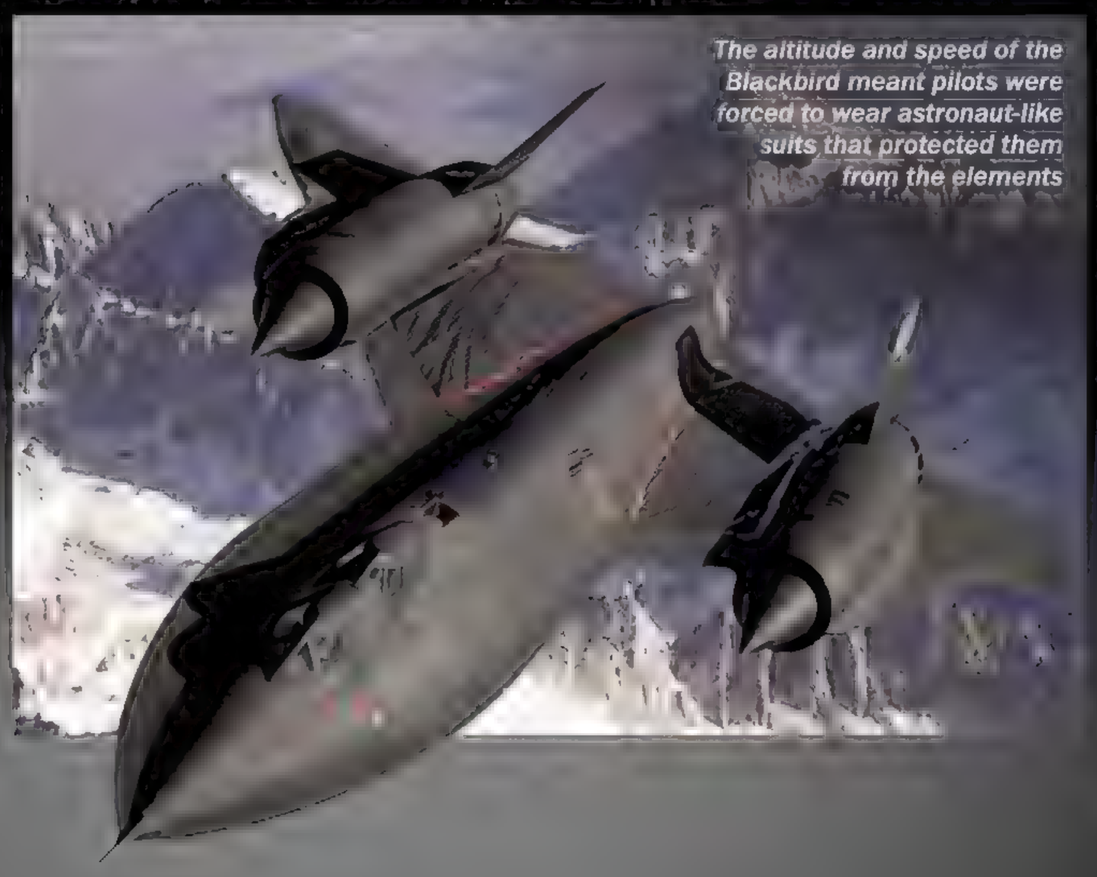
TECHNICAL ASPECTS

COUNTRY OF ORIGIN: Soviet Union
FIRST PRODUCED: 1947
LENGTH: 88cm (35in)
ACTION: Gas-operated rotating bolt
RANGE: 400m (1310ft)
AMMUNITION: 7.62x39mm rounds

08 THE BLACKBIRD

Originally kept under wraps as a US and UK secret Black Project, the Lockheed SR-71 Blackbird was a technological wonder. The fastest plane of all time (reaching an eye-melting 2,530km/h (2,193mph), it was also one of the highest flying military aircraft ever made. The plane was so fast, it even broke both the sound and heat barriers and required both a specialist fuel and a titanium structure to fly.

Devised after the U2 incident in 1960, the Blackbird demonstrated that the US needed a quicker and higher flying reconnaissance aircraft that couldn't be tracked by the USSR. The designers of the Blackbird described it as their hardest ever assignment, as the plane was so different and advanced compared with anything that came before. 32 were constructed in total and served as scouting aircraft for over 30 years. The details of a vast majority of these missions are still classified.



The altitude and speed of the Blackbird meant pilots were forced to wear astronaut-like suits that protected them from the elements

09 ENIGMA MACHINE

Highly sophisticated devices for their time, Enigma machines held the key to many of the Wehrmacht's secrets. An electro-mechanical rotor cipher machine, the device was used by the Third Reich to transmit and receive covert messages and tactics without the risk of being decoded.

Capable of millions of combinations, the Allies captured many of these messages but were only able to break the code in 1940 with the help of Polish experts from the Government Code and Cypher School (GC&CS) in Bletchley Park, England. The code was eventually broken by using a device called a Bombe, which could attempt hundreds of potential codes per minute until it found the correct combination.

It has been speculated that this breakthrough shortened the war by up to two years, such was the effectiveness and importance of the machine.

The Enigma machine was so effective, British agents had to play down their successes so the Axis powers didn't get wind of their discovery

10 AH-64 APACHE ATTACK HELICOPTER

THIS HELICOPTER GUNSHIP IS THE TANK'S WORST ENEMY AND CAN ELIMINATE VAST SWATHES OF HEAVY INFANTRY IN SECONDS

Since their inception in the late 20th Century, advanced attack helicopters have been a nightmare for troops both on land and at sea – the most notable of these is the AH-64 Apache.

Prior to attack helicopters, infantry could advance along territory, with infrequent air strikes from bombers being their only airborne concern. Now, with a chain-gun-equipped helicopter prowling the skies, tactics and strategies have become very different. The AH-64 can be assigned to almost any mission, from destroying fortifications to delaying and disrupting the movement of troops. It's even more dangerous at night, with the help of Target Acquisition Designation Sight (TADS) and Pilot Night Vision Sensors (PNVS).

The gunship's M230 chain gun can strafe and lay waste to infantry, while Hellfire missiles can take down armoured vehicles, ships and structures. If the Apache is threatened from the air, its Hydra rockets will combat most aerial rivals. The US Army has ordered over 800 of the machines since they were first introduced, while others have found their way into the Israeli and Egyptian air forces. The advanced attack helicopter reached its zenith in Operation Desert Storm, where it was used to decimate 500 Iraqi tanks and other armoured vehicles.

Apaches have a rapid response rate to enemy threats, and can be deployed far quicker than land-based vehicles. Additionally, the gunship requires far less space and fewer resources than fighter jets. The AH-64 can also be called upon in all manner of inhospitable conditions.

Naturally, various methods have been devised to combat the attack helicopter, and militants that come into contact with the Apache now carry rocket-propelled grenades.

TECHNICAL ASPECTS

COUNTRY OF ORIGIN: USA
FIRST PRODUCED: 1983
LENGTH: 17.73m (58.17ft)
WEIGHT: 7,270kg (16,027lb)
TOP SPEED: 149kn (273km/h/170mph)
WEAPONRY: Hellfire laser-designated missiles, M230 chain gun, Hydra rockets

COCKPIT
State-of-the-art technology fills the two-person cockpit, controlling the advanced weaponry, long-range communication systems and pinpoint navigation systems.

COMPOSITE FOUR-BLADE MAIN ROTOR

ENGINE
Helicopters are reliant on their manoeuvrability, so the T700 Turboshaft engine gives the Apache a climb rate of 663mpm (2,175fpm) and a top speed of 284km/h (177mph).

COMMUNICATION, WEAPON AND NAVIGATION SYSTEMS

LIGHT AND CAMOUFLAGED FUSELAGE

TARGETING SYSTEM

AUTOMATIC CANNON
When missiles or rockets can't be used, a 30mm chain gun is used to blast through other aircraft, infantry and smaller buildings.

HELLFIRE MISSILES
Laser-guided, a Hellfire air-to-surface missile can rip through armoured vehicles and bunkers with ease. They are particularly effective against tanks.

HYDRA ROCKETS
Slightly lighter than the heavy-duty Hellfires, Hydra rockets can be used against other aircraft or smaller ground targets.

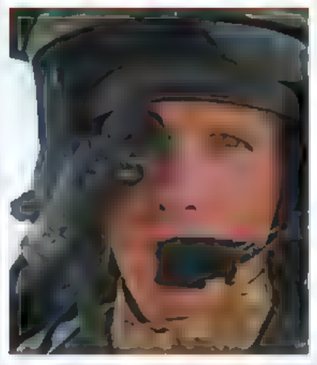
IN ACTION HELLFIRE IN THE PERSIAN GULF

In collaboration with the F-117 Nighthawk Stealth Fighter, attack helicopters took on Saddam Hussein's forces in the 1991 Gulf War. The Iraqi Army was relatively well equipped after purchasing many tanks from the USSR, but they didn't stand a chance against the might of the Apache, as missiles and machine-gun fire tore through the heavy armour.

They were so successful that only one was downed in reply to hundreds of Iraqi tanks. Saddam's forces retreated from Kuwait within 100 hours, as the invasion of Kuwait ended abruptly. Into the new millennium, Apaches still held a key role in the US Army as a support vehicle in the Kosovo and Afghan wars. It's now also been utilised in the Israeli Army.

FLYING ON THE FRONTLINE

MAJOR ALEX HARRIS OF THE UK ARMY AIR CORPS SHARES HIS EXPERIENCES OF FLYING APACHE AIRCRAFT



HOW LONG DOES IT TAKE TO TRAIN TO FLY AN APACHE? IS IT INITIALLY DIFFICULT TO HANDLE?

You first have to complete the army pilot's course, which is modular and takes about two years. Once you have been awarded your army flying wings you might get selected to train on the Apache. The first part is called Conversion to Type (CTT), which teaches you how to fly the aircraft and lasts about six months. If successful, you move on to the next phase which is called Conversion to Role (CTR). This teaches you how to fly the aircraft in all scenarios and also lasts six months.

The culmination is the live firing of all the Apache weapon types in Arizona, USA. You are then a qualified Apache pilot. Even after all of that, you are constantly learning and attending different courses. These could be such things as learning to operate from a Royal Navy ship, or becoming a weapons instructor. Initially it can be quite difficult to fly, as it's much larger and more complex than the training aircraft.

The courses are all progressive though and you can't advance until you have mastered the basics. The aircraft has a very good stabilisation system to ensure that it's a steady platform from which to launch weapons, so when these are working for you it is a great aircraft to fly.

WHAT WAS THE APACHE'S ROLE IN THE THEATRES YOU FLEW IN AND HOW EFFECTIVE WAS IT?

Its main role was to support the ground forces with precision weapons when they got engaged by the Taliban and were pinned down. With a talk on over the radio from the ground forces, the Apaches were able to identify the enemy, single them out from the population and built-up areas, before decisively engaging them.

We also escorted the Chinooks that carried the Medical Emergency Response Team (MERT). This life-saving asset often picked up seriously wounded casualties from the battlefield while the firefight still went on around them. They were a big target for the Taliban and it was our job to try and destroy the enemy before they could engage them.

DOES THE HELICOPTER FORM PART OF A SQUAD OR IS IT FLOWN SOLO WHEN ON THE ATTACK?

Although they can work alone, Apaches would normally work as a pair. This is known as a Flight. During an engagement one aircraft would act as the shooter and the other as the looker. This means that while one is zoomed in on the target, the other aircraft is looking out wider for more targets in depth. The looker will also put himself in a position to follow up on the first aircraft's attack if necessary. If the Squadron is fighting together you may find two or more Flights working in an engagement area to prosecute targets.

HOW DOES YOUR CO-PILOT ASSIST YOU?

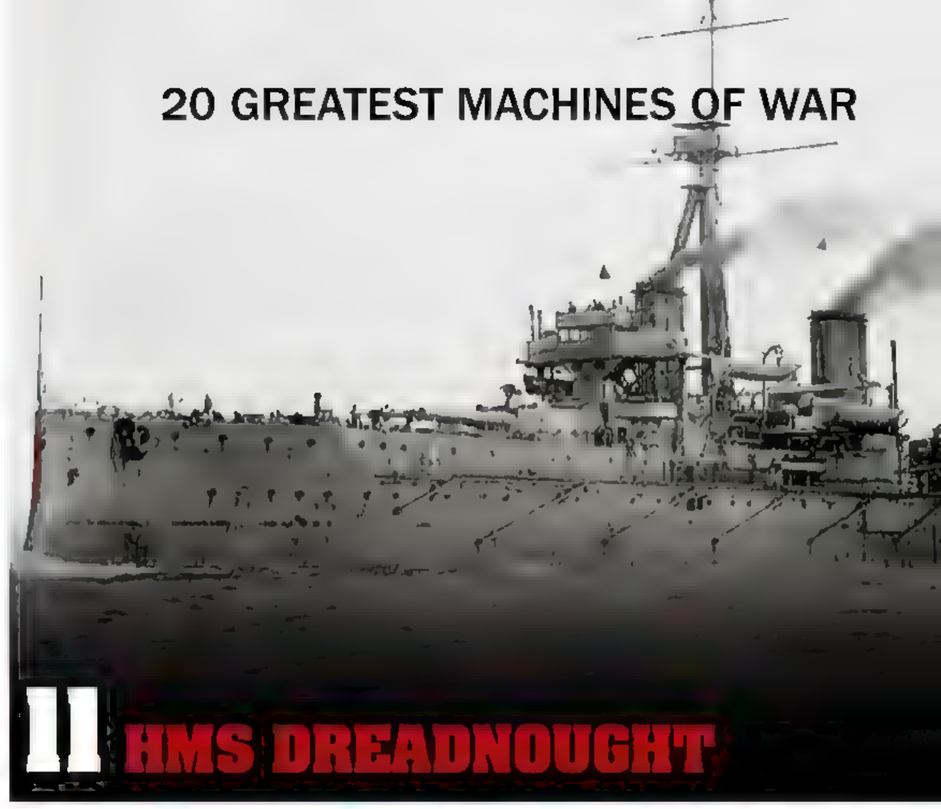
While the Co-Pilot Gunner is heads-down in the sight looking for enemy, the pilot is looking after the safety of the aircraft. He is monitoring the systems and ensuring that all is as it should be, but more than that he is watching for any close-in enemy trying to shoot them down. With the Helmet Mounted Display, the pilot is only a couple of button presses away from firing the 30mm. It can be slaved to his head position so that wherever he looks, all he has to do is pull the trigger and he is firing on-target.

HAVE YOU EVER HAD TO MAKE A EMERGENCY LANDING?

In Afghanistan on Very High Readiness (VHR) we got a call to go and support some ground forces who were under fire. However, not long after take off, one of our two engines developed a serious fault and started to break up, so we had to shut it down. Because of the weight of the weapons we had on board and the fact that our performance was low in the hot and high conditions, we were unable to maintain level flight and so started to descend to the desert floor. We worked out that we could just about make it back to Camp Bastion before we would hit the deck, so we nursed it back to the Apache landing strip, landed on and parked up. We jumped straight out of that one and moved our kit into the aircraft next to it, getting back out in under five minutes. We eventually got to the site of the battle and were engaging with Hellfire missiles and 30mm within minutes of arriving.

WHAT WAS YOUR MOST MEMORABLE FLIGHT?

Probably the first time I ever fired the weapons in a combat situation. We were fighting in the middle of a city and some enemy armed with heavy weapons and suicide vests had taken over the top two floors of a hotel that overlooked a friendly camp. They were firing down into the camp and causing friendly casualties. We arrived not long after it began and I remember thinking that if I got this wrong in such a built-up area, then the consequences could be terrible. However, the training soon kicked in and operating as a crew and as a Flight, we successfully defeated the enemy. I do remember afterwards that the hotel had some serious holes in it and I'd have some explaining to do when I got back to base.



11 HMS DREADNOUGHT

THE DAWN OF THE FIRST DREADNOUGHT BATTLESHIP REVOLUTIONISED NAVAL WARFARE PRIOR TO TWO WORLD WARS

If there's one war machine that demonstrated the intensity of the Anglo-German arms race, it was the Dreadnought class of battleship. The first, HMS Dreadnought, was completed in 1906 and completely eclipsed what came before. With its steam turbine powerplant, it could roar through the waves at high speeds while aiming the most heavily armed naval guns in history at an enemy vessel. It was the first vessel to focus entirely on 'big gun' armament, which had a range of a massive 22.8 kilometres (14.2 miles). The guns were controlled by all-new electronic transmitting equipment that could aim the artillery incredibly accurately for the time.

Dreadnought was even the first ship to house the captain and officers nearer the bridge at the front, unlike the old layout seen on tall ships in the age of sail. With such advanced armament and technology, the design became immensely popular and by 1914 the Royal Navy had constructed 19, while the Imperial German Navy had 13 in its fleet. The impact was so great that only a year later 'Super-Dreadnoughts' were being produced. The Dreadnought class had revolutionised the war at sea and a constant stream of updated models would follow right up until the height of the Cold War, when nuclear submarines began to change naval combat once again.

TECHNICAL ASPECTS

COUNTRY OF ORIGIN: Great Britain
FIRST PRODUCED: 1906
LENGTH: 160m (525ft)
WEIGHT: 18,400 tonnes
TOP SPEED: 21 knots (39kmh/24mph)
WEAPONRY: Ten 305mm guns, 24 76mm guns, five torpedo tubes

KEY TECHNOLOGY

Without the steam turbine, the Dreadnought class of battleship would have not been the significant machine it was. The innovative technology was a British invention from 1884, but this was the first time it was used on a warship. The system replaced the triple-expansion engine that had been used so extensively in older ships and made HMS Dreadnought the fastest battleship in the world. With the new mechanism, the battleship now had a range of roughly 12,260km (7,620mi).

The Minigun enabled a weapon with the power of the M61 Vulcan to be used on ships, turrets and armoured vehicles

TECHNICAL ASPECTS

COUNTRY OF ORIGIN: USA
FIRST PRODUCED: 1959
LENGTH: 182cm (72in)
ACTION: Hydraulically operated belt-fed unit
RATE OF FIRE: 6,000 rounds per minute
AMMUNITION: 20x102mm rounds

12 M61 VULCAN

THE GATLING GUN OF THE MODERN ERA, THE M61 VULCAN SHOWCASES THE TRUE POWER OF CONTEMPORARY HAND-OPERATED WEAPONS

A gigantic weapon of war, the M61 Vulcan was initially devised as an anti-aircraft gun. Its rotating six-bolt barrel gives it a much higher rate of fire and reliability than single-barrel machine guns, which would overheat after persistent use.

An ammo belt was originally used to feed the bullet-hungry firearm, but after a jamming problem the belts were replaced by a linkless feed system. The gun is powered both hydraulically and electrically by aircraft and can fire both incendiary and armour-piercing rounds. The invention of the weapon gave fighter jets an alternative to using missiles at short range and has one of the highest firing rates of any machine gun. The M61 has also been used on the ground as an air defence system in armoured vehicles and its successor, the M134 Minigun, was used in helicopters as a response to RPG fire from the ground.

The M134 has made the weapon class much more effective, as it can be placed on gun emplacements. This scaled-down version of the original made the weapon more readily transportable but with a decreased rate of fire. Despite its inability to be carried and fired by a single infantryman (as is often the myth), the M61 Vulcan has made all types of military aircraft much more resistant to ground fire and more effective at taking out ground units. Its high rate of fire means successful hits are achievable even at jet speeds.

KEY TECHNOLOGY

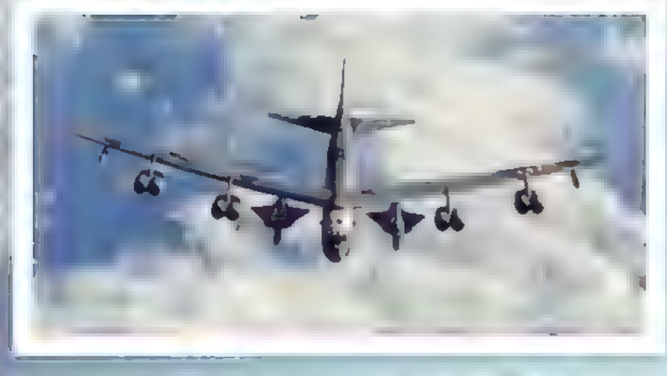
Overheating was always an issue with machine guns with a high rate of fire, but the M61 Vulcan managed to remedy this downside. By using six separate barrels firing 1,000 rounds a minute, none of the systems would overheat or malfunction but 6,000 rounds of ammunition would still be fired off in a minute's worth of firing. This was extremely useful on military aircraft where a fault could not be fixed mid-flight.

13 B-52 STRATOFORTRESS

This gigantic bomber was one of the biggest and most powerful aircraft ever made. Powered by eight engines, its original purpose was to carry atomic bombs behind the Iron Curtain if relations with the Soviet Union soured. Thankfully, it never had the opportunity to deploy its one-megaton nuclear warhead, so it was confined to bombing missions using conventional munitions.

It proved to be very versatile plane, carrying up to 27,216 kilograms (60,000lbs) of bombs ranging from nuclear to precision-guided cruise missiles. The B-52 was hugely effective during Vietnam and the Gulf Wars and its descendants have been in frequent use in Iraq and the Balkans. The plane's sheer bulk means that the B-52 is also used as a carrier for air rocket launches. The success of this war machine has meant that it's now the longest serving bomber in US military history and is set to remain in operation into the 2050s.

The B-52 is an exceptional air launcher. Here it is (inset) carrying two Lockheed D-21 reconnaissance drones



14 HUMVEE

The HUMVEE saw widespread use in the Gulf War and has become and integral part of the US Army since

After the Vietnam War, the aging US M151 Jeep was in drastic need of an upgrade. The result finally came in the early 1980s, when the High Mobility Multipurpose Wheeled Vehicle (HMMWV/HUMVEE) was developed.

Designed as an infantry support vehicle, the HUMVEE features great all-round capabilities and could even be dropped into battle from the air. Lightweight and four-wheel drive, the vehicle is highly flexible and can perform a variety of battlefield and reconnaissance roles. It provides an essential middle ground between surveillance and the heavy artillery rolling in.

A HUMVEE can carry a variety of equipment, from machine guns to missile launchers, and so can also act as a store for weaponry and ammunition. Since its inception there have been numerous improvements on the original design, and the vehicle has subsequently become a staple of the US Army.

15 USS NAUTILUS (SSN-571)

In the post-World War era, nuclear power was blazing its way into many naval propulsion systems, providing extra power, speed and range. The first to embrace this new power source was the USS Nautilus (SSN-571), the first nuclear submarine, completed in 1955.

With this new power cell, submarines could theoretically spend unlimited amounts of time underwater, a feature that would become imperative in the Cold War. The USSR's first nuclear sub, the K-3, followed hot on the heels of the Nautilus in 1958, but could only watch as its rival smashed submerged speed and distance records.

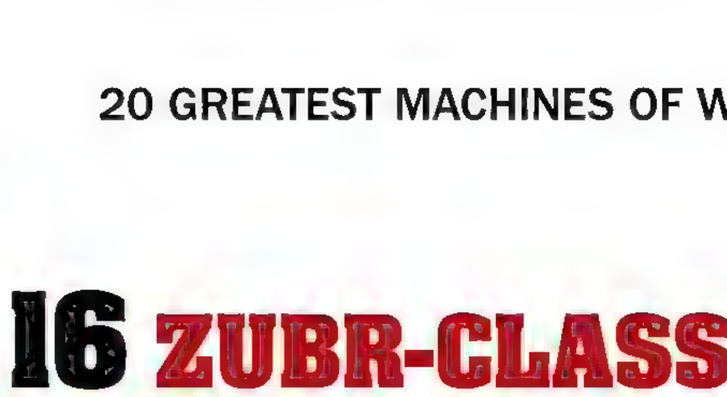
The nuclear age had begun, so US and Soviet submarines would closely monitor one another for the remainder of the war. The influence of the Nautilus can be seen today in the Trident UK nuc deterrent system and the le still patrol the depths.

The phrase "underway on nuclear power" was uttered for the first time on 17 January 1955 as the Nautilus began its maiden voyage

16 ZUBR-CLASS LCAC MILITARY HOVERCRAFT

The largest class of military hovercraft in the world is the Zubr, which became an important part of warfare after its inception in 1988. Providing the same role that transport helicopters do for ground troops, the Zubr can sealift men, tanks and other armoured vehicles right up to the shoreline in coastal assaults.

There are currently nine in this class of military hovercraft in active service within the Russian, Ukrainian and Greek navies



"THE ZUBR CAN SEALIFT MEN, TANKS AND OTHER ARMOURED VEHICLES RIGHT UP TO THE SHORELINE"

17 MIG-15

The Mikoyan MiG-15 emerged from the Iron Curtain in 1950 as a total shock to the Western world. Its first assignment was in the Korean War, where it outclassed the US fighters and single-handedly caused the American F-86A Sabre to be rushed off the production line. 8,000 MiGs were built within five years as it set the template for future jet fighters.

Though a marvel of Soviet engineering, MiG-15s were powered by British Rolls Royce engines

A specialised Machine Gun Corps was created in 1915 to give the weapon a higher status in the British army.

IN ACTION

THE SOMME MACHINE-GUN MASSACRE

With more than a million men killed, the 1916 Battle of the Somme is believed to be one of the bloodiest battles in human history. This was partly down to the lack of tactics to combat the new weapon of the generation, the machine gun. Unaware of the awesome power of the weapon, both sides were sitting ducks when wading through the thick mud against a wall of bullets. Reports suggested that Vickers guns alone fired in excess of a million rounds over a 12-hour period. Originally used as a defensive battlefield support weapon, the Battle of the Somme showed just how devastating machine-gun fire could be when used in an offensive capacity. With the stalemate of trench warfare ending, it was imperative that machine guns became lighter and more compact. This led to the invention of lighter machine guns and, latterly, assault rifles.

18 VICKERS MKI

DEVELOPED IN THE EARLY 20TH CENTURY, THIS MACHINE GUN WOULD REVOLUTIONISE THE WAY BATTLES WERE FOUGHT AND HOW ARMIES WERE TRAINED

It may not have been the first machine gun, but the Vickers MK 1 was essential to the rapid changes in warfare at the start of the century. Both the Gatling and Maxim guns preceded it, but its development in 1912 saw the Vickers become the most reliable and versatile machine gun of its day.

By using a water-cooling jacket around the barrel, it could fire off rounds more accurately and quicker than ever before. The wall of bullets spelled the end for infantry formations and accelerated the beginning of trench warfare and no-man's land. Huge pitched battles with massive assembled infantry divisions would be no more.

Weighing in at 20 kilograms (44 pounds), the gun would be placed in a hidden position and fired on unsuspecting foes. Its bulk meant it had to be static to be effective, but in such a slow-moving conflict, this wasn't a problem.

However, it was more than just a gun – the Vickers would contain a water-condensing can and hose, a wooden sight, ammunition box and a canvas jacket. All this would be operated by a crew of up to six soldiers. Without a water supply (one batch would evaporate after 750 rounds had been fired), it would quickly overheat, so gas-powered machine guns soon became preferred.

The Vickers' counterparts in the field of battle were the German MG08 and French Hotchkiss. The gun was so popular that 12 were being made every week for the British Army and 39,473 were in use by 1918. The Vickers Company even had to lower its price to £80 per gun, so the government could finance the demand. In fact, the guns proved to be even more versatile than first thought and, armed with an interrupter gear, were attached to the fighters of the Royal Flying Corps. The fighters were now able to take on the Imperial German Air Force in ever-deadlier dogfights. As the Great War wore on, the Vickers was slowly phased out by the Lewis gun, which boasted improved reliability and accuracy. However, the Vickers name did make a comeback with later gas-operated models lasting up to the Second World War. In fact, the British Army only considered the weapon completely obsolete in the late 1960s. The gun was an important template for later weapons, such as the MG32 and Browning, and was the first to successfully work on and improve the Maxim gun. Warfare has never been the same since.

TECHNICAL ASPECTS

COUNTRY OF ORIGIN: Great Britain
FIRST PRODUCED: 1912
LENGTH: 58cm (38.5in)
CALIBRE: .303in
RATE OF FIRE: 450-550 rounds per minute
FIRING RANGE: 4,100m (13,451ft)

FIRING MECHANISM

The Vickers had an operating life of around 18,000 rounds before the accuracy of the weapon began to falter. Spare barrels were carried by gun teams, as well as a tripod to keep the gun steady.

COOLANT SYSTEM

Many of the first generation of belt-fed machine guns were water-cooled. On the Vickers a jacket of water would surround the barrel to cool the mechanism and enable it to fire for longer periods of time without overheating.

OTHER USES

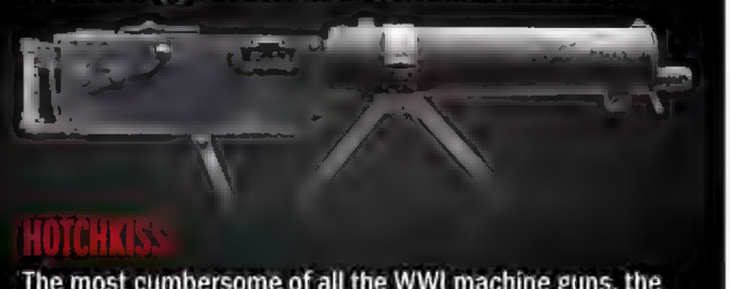
As well as cutting down infantry regiments, the Vickers could be tilted vertically to use as makeshift artillery. A muzzle-booster could also be fitted to the mechanism to improve the rate of fire.

MACHINE-GUN LEGACY

THE VICKERS' RIVALS AND THE GUNS IT WOULD INFLUENCE

MG08

The German machine gun of choice in the First World War, the Maschinegewehr 08 was very similar to the slightly older British Maxim gun. At its peak, over 14,000 were being churned out of German factories every month and it was upgraded to an air-cooled model in 1918.

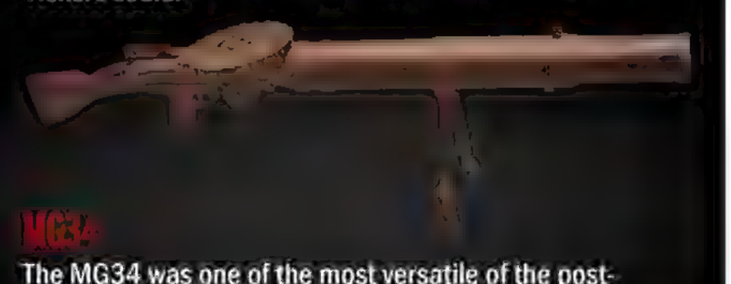


HOTCHKISS

The most cumbersome of all the WWI machine guns, the French Hotchkiss had a lower fire rate than the MG08 and Vickers. As the war went on, the French switched to using the Chauchat light machine gun as more mobile firearms became preferable.

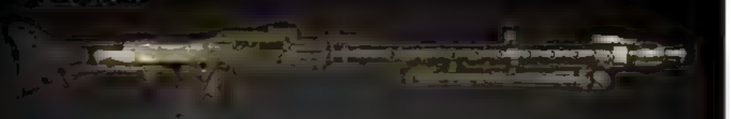
LEWIS GUN

Used by the British in the Great War, the Lewis gun used a circular magazine rather than a belt-fed mechanism. This highly effective weapon was nicknamed the 'Belgian Rattlesnake' by the Germans and was used in unison with the Vickers. It began to phase the Vickers out as it was discovered that six could be made in the time that one Vickers could.



MG34

The MG34 was one of the most versatile of the post-Vickers guns. The Wehrmacht created the Maschinegewher 34 so it could be used on a bipod, a tripod or even without a mount. Effective and powerful, it was replaced by the MG42, which is considered once of the best machine guns of all time.



M1917 [illegible]

Perhaps the longest serving of all machine guns of the era, the M1917 was used from World War One right up until the Vietnam War. It was designed by the USA and signified their development as a military power, as before the Browning, their machine guns were very outdated compared to the European equivalents.

Flamethrowers are unstable weapons of war, but there aren't many war machines that inspire as much terror

19 FLAMETHROWER

The turn of the 20th century signalled the dawn of a devastating new weapon in warfare: the modern flamethrower. Yet another war machine devised to end the horrors of trench warfare, the flamethrower first saw battle on the Western Front as both sides attempted to flush out enemy trenches.

The original weapon was operated by two men and had a range of up to 40 metres (131 feet), however, they had limited usage as they only had enough oil for 40-second bursts.

Flamethrowers were later installed on tanks in the Second World War and were highly effective as a shock weapon. The armoured protection negated the weapon's lengthy reload times and a tank could store additional fuel to reload. Due to their inconsistent nature, flamethrowers have been gradually phased out of military use, but are still readily used by militant groups. These shocking weapons have encouraged the use of other incendiary weapons such as napalm and thermobaric bombs.

20 USS ENTERPRISE (CVN 65)

In 1962 a new supercarrier was born that would be the first nuclear-powered aircraft carrier ever built. Made of nearly 100,000 tons of metal, the USS Enterprise could carry over 60 aircraft and represented a new dawn for seagoing air bases.

Powered by eight reactors, it was thrust into action almost immediately, as it participated in the blockade on Cuba in the wake of the 1962 Cuban Missile Crisis. In 1965 it became the first nuclear-powered ship to engage in conflict as it entered the Vietnam War to provide support for the frontline troops. Nicknamed 'Big E', she is still the longest naval vessel in the world and has opened up a whole new era for supercarriers. The major carriers since include the entire Nimitz class of carrier and the US class leader USS Gerald R Ford.

The Enterprise is a fully-functioning floating battlestation with a 1.8-hectare (4.5-acre) flight deck and a 1.4-hectare (3.5-acre) hangar

Alamy, DK Images; Corbis

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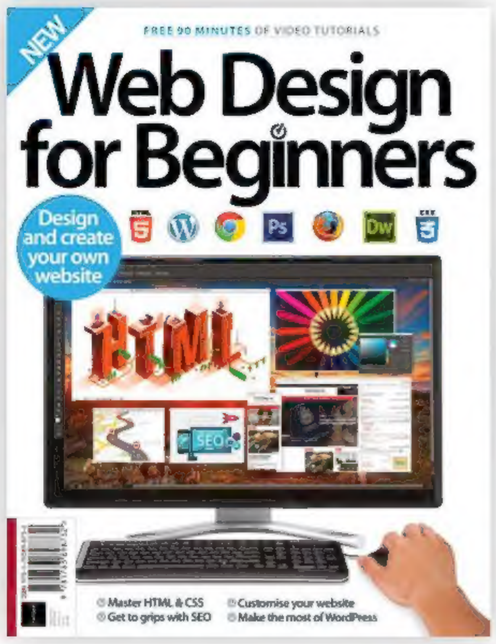

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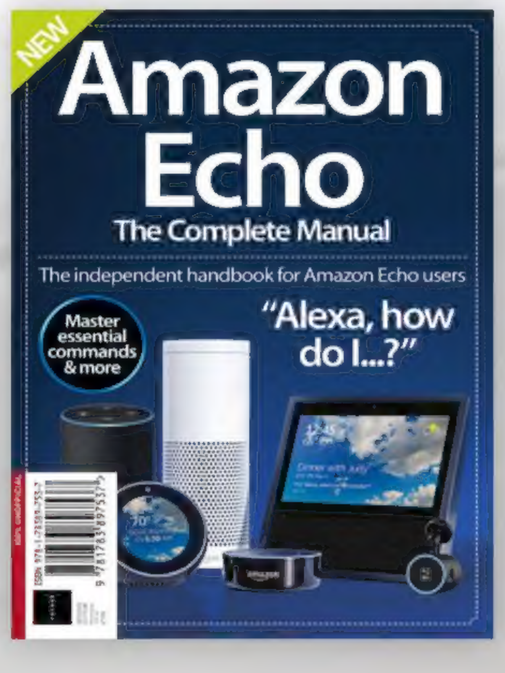

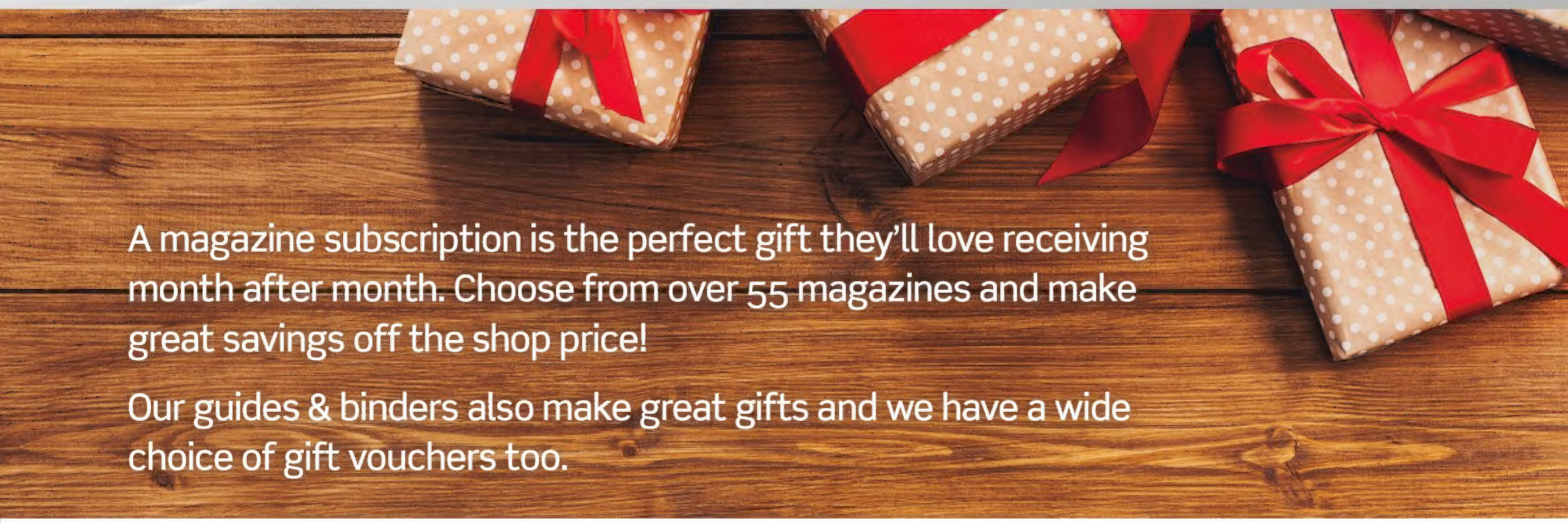

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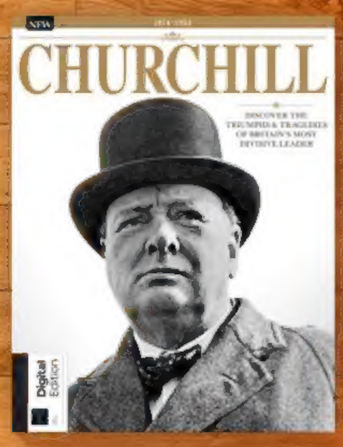

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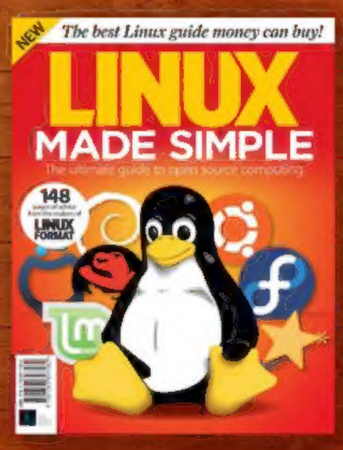

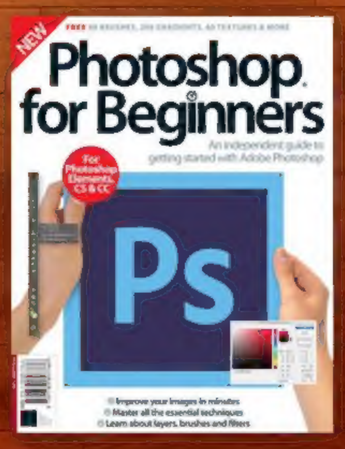

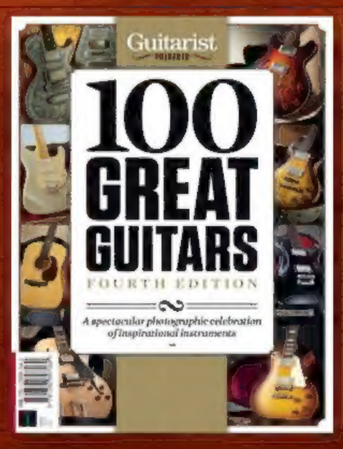

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